



DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XE497

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to BlueCrest Alaska Operating, LLC Drilling Activities at Cosmopolitan State Unit, Alaska, 2016

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received an application from BlueCrest Alaska Operating, LLC (BlueCrest) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to conducting an oil and gas production drilling program in lower Cook Inlet, AK, on State of Alaska Oil and Gas Lease 384403 under the program name of Cosmopolitan State during the 2016 open water season. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to BlueCrest to incidentally take, by Level B harassment only, marine mammals during the specified activity.

DATES: Comments and information must be received no later than **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: Comments on the application should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. The mailbox address for providing email comments is *ITP.Youngkin@noaa.gov*. NMFS is not responsible for e-mail comments sent

to addresses other than the one provided here. Comments sent via e-mail, including all attachments, must not exceed a 25-megabyte file size.

Instructions: All comments received are a part of the public record and will generally be posted to <http://www.nmfs.noaa.gov/pr/permits/incidental.htm> without change. All Personal Identifying Information (e.g., name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

An electronic copy of the application, NMFS' Draft Programmatic Environmental Assessment (EA) for activities in Cook Inlet, and a list of the references used in this document may be obtained by visiting the internet at: <http://www.nmfs.noaa.gov/pr/permits/incidental.htm>. In case of problems accessing these documents, please call the contact listed below. Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Dale Youngkin, Office of Protected Resources, NMFS, (301) 427-8401.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking; other means of effecting the least practicable impact on the species or stock and its habitat; and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined “negligible impact” in 50 CFR 216.103 as “...an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.”

Except with respect to certain activities not pertinent here, the MMPA defines “harassment” as: “any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].”

Summary of Request

On September 28, 2015 NMFS received an IHA application from BlueCrest for the taking of marine mammals incidental to an oil and gas production drilling program in lower Cook Inlet, AK, during the 2016 open water season. Typically, the open water (*i.e.*, ice-free) season is mid-April through October; however, BlueCrest would only operate during a portion of this season, from August 1, 2016 through October 31, 2016. NMFS determined that the application was adequate and complete on April 12, 2016.

BlueCrest proposes to conduct an oil and gas production drilling program using the

Spartan 151 drill rig (or similar rig) in lower Cook Inlet. This work would include drilling up to three wells with a total operating time of approximately 91 days during the 2016 open-water season, (August 1 through October 31). In 2013, BlueCrest, then in partnership with Buccaneer Energy, conducted exploratory oil and gas drilling at the Cosmopolitan State #A-1 well site (then called Cosmopolitan State #1). Beginning in 2016, BlueCrest intends to drill two more wells (Cosmopolitan State #A-2 and #A-3). These directionally drilled wells have top holes located a few meters from the original Cosmopolitan State #A-1, and together would feed to a future single offshore platform. Both #A-2 and #A-3 may involve test drilling into oil layers. After testing, the oil horizons will be plugged and abandoned, while the gas zones will be suspended pending platform construction. A third well (#B-1) will be located approximately 1.7 kilometers (km; 1 mile [mi]) southeast of the other wells. This well will be drilled into oil formations to collect geological information. After testing, the oil horizon will be plugged and abandoned, while the gas zones will be suspended pending platform construction. All four wells (one existing and up to three new) would be located within Lease 384403. Specific locations (latitude and longitude and depth) of each well is provided in Table 1-1 and depicted in Figure 1-1 of BlueCrest's application.

The following specific aspects of the proposed activities are likely to result in the take of marine mammals: 1) impact hammering of the drive pipe at the well prior to drilling, and 2) vertical seismic profiling (VSP). Underwater noise associated with drilling and rig operation associated with the specified activity has been determined to have little effect on marine mammals (based on Marine Acoustics, Inc.'s [2011] acoustical testing of the *Spartan 151* while drilling). Take, by Level B harassment only, of nine marine mammal species is anticipated to result from the specified activity.

Description of the Specified Activity

Overview

BlueCrest proposes to conduct oil and gas production drilling operations at up to three sites in lower Cook Inlet during the 2016 open water (ice-free) season (August 1 through October 31), using the *Spartan 151* jack-up drill rig, depending on availability. The activities of relevance to this IHA request include: impact hammering of the drive pipe and VSP seismic operations. BlueCrest proposes to mobilize and demobilize the drill rig to and from the well locations, and will utilize both helicopters and vessels to conduct resupply, crew change, and other logistics during the drilling program. These mobilization/demobilization activities, and actual drilling/operation of the rig, are also part of the proposed activity but are not considered activities of relevance to this IHA because take is not being authorized for those activities. More information regarding these activities and why they are/are not considered activities of relevance to this IHA can be found in the Detailed Description of Activities section below.

Dates and Duration

The 2016 drilling program (which is the subject of this IHA request) would occur during the 2016 open water season (August 1 through October 31). BlueCrest estimates that the drilling period could take up to 91 days in the above time period. The exact start date is currently unknown, and dependent on the scheduling availability of the proposed drill rig. It is expected that each well will take approximately 30 days to complete, including well testing time.

During this time period, drive pipe hammering would only occur for a period of 1 to 3 days at each well site (although actual sound generation would occur only intermittently during this time period), and VSP seismic operations would only occur for a period of less than 1 to 2 days at each well site. This IHA (if issued) would be effective for 1 year, beginning on August 1,

2016.

Specified Geographic Region

BlueCrest's proposed program would occur at Cosmopolitan State #B-1 (originally Cosmopolitan #2), Cosmopolitan State #A-1 (originally Cosmopolitan State #1), #A-2, and #A-3 in lower Cook Inlet, AK. The exact location of BlueCrest's well sites can be seen in Figure 1-1 in BlueCrest's IHA application and location information (latitude/longitude and water depth) is provided in Table 1-1 in the IHA application.

Detailed Description of Activities

1. Drill Rig Mobilization and Towing

BlueCrest proposes to conduct its production and exploratory drilling using the *Spartan 151* drill rig or similar rig (see Figure 1-2 of the IHA application). The *Spartan 151* is a 150 H class independent leg, cantilevered jack-up drill rig, with a drilling capability of 25,000 ft but can operate in maximum water depths up to only 150 ft. The rig will be towed by ocean-going tugs licensed to operate in Cook Inlet. While under tow, the rig operations will be monitored by BlueCrest and the drilling contractor management, both aboard the rig and onshore.

The *Spartan 151* is currently moored at the Seward Marine Industrial Center, directly across Resurrection Bay from the City of Seward. The intention is to move the drill rig to the Cosmopolitan Site #B-1 well site in July, a distance of approximately 314 km (195 miles [mi]). It is anticipated that this tow would be accomplished within three days. Any move post-project will be controlled by the owner of the drilling rig. The rig will be towed between locations by ocean-going tugs that are licensed to operate in Cook Inlet. Move plans will receive close scrutiny from the rig owner's tow master as well as the owner's insurers, and will be conducted in accordance with state and federal regulations. Rig moves will be conducted in a manner to minimize any

potential risk regarding safety as well as cultural or environmental impact.

The rig will be wet-towed by two or three ocean-going tugs licensed to operate in Cook Inlet. Ship strike of marine mammals during tow is not an issue of major concern. Most strikes of marine mammals occur when vessels are traveling at speeds between 24 and 44 km/hr (13 and 24 knots [kt]) (http://www.nmfs.noaa.gov/pr/pdfs/shipstrike/ss_speed.pdf), well above the 1.9- to 7.4-km/hr (1- to 4-kt) drill rig tow speed expected. However, noise from towing was considered as a potential impact. Tugs generate their loudest sounds while towing due to propeller cavitation. While these continuous sounds have been measured at up to 171 dB re 1 μ Pa-m (rms) at 1-meter source (broadband), they are generally emitted at dominant frequencies of less than 5 kHz (Miles *et al.*, 1987; Richardson *et al.*, 1995a, Simmonds *et al.*, 2004). For the most part, the dominant noise frequencies from propeller cavitation are significantly lower than the dominant hearing frequencies for pinnipeds and toothed whales, including beluga whales (Wartzok and Ketten, 1999), so towing activities are not considered an activity that would ‘take’ marine mammals.

2. Drive Pipe Hammering

A drive pipe is a relatively short, large-diameter pipe driven into the sediment prior to the drilling of oil wells. This section of tubing serves to support the initial sedimentary part of the well, preventing the looser surface layer from collapsing and obstructing the wellbore. Drive pipes are usually installed using pile driving techniques. The term ‘drive pipe’ is often synonymous to the term ‘conductor pipe’; however, a 50.8-centimeter (cm; 20-inch [in]) conductor pipe will be drilled (not hammered) inside the drive pipe, and will be used to transport (conduct) drillhead cuttings to the surface. Therefore, there is no noise concern associated with the conductor pipe drilling, and the potential for acoustical harassment of marine mammals is

due to the hammering of the drive pipe. BlueCrest proposes to drive approximately 200 ft (60 m) below mudline of 30-inch drive pipe at each of the well sites prior to drilling using a Delmar D62-22 impact hammer. This hammer has impact weight of 13,640 pounds (6,200 kg) and reaches maximum impact energy of 165,215 foot-pounds (224 kilonewton-meters) at a drop height of 12 ft (3.6 m).

Blackwell (2005) measured the noise produced by a Delmar D62-22 driving 36-inch steel pipe in upper Cook Inlet and found sound pressure levels (SPLs) to exceed 190 dB re 1 μ Pa-m (rms) at about 200 ft (60 m), 180 dB re 1 μ Pa-m (rms) at about 820 ft (250 m), and 160 dB re 1 μ Pa-m (rms) at just less than 1.2 mi (1.9 km). Illingworth and Rodkin (2014) measured the hammer noise operating from another rig, the *Endeavour*, in 2013 and found SPLs to exceed 190 dB re 1 μ Pa-m (rms) at about 180 ft (55 m), 180 dB re 1 μ Pa-m (rms) at about 560 ft (170 m), and 160 dB re 1 μ Pa-m (rms) at 1 mi (1.6 km). The drive pipe driving event is expected to last 1 to 3 days at each well site, although actual sound generation (pounding) would occur only intermittently during this period.

3. Drilling and Standard Operation

The *Spartan 151* was hydro-acoustically measured by Marine Acoustics, Inc. while operating in 2011. The survey results showed that continuous noise levels exceeding 120 dB re 1 μ Pa (NMFS' current threshold for estimating Level B harassment from continuous underwater noise) extended out only 164 ft (50 m), and that this sound was largely associated with the diesel engines used as hotel power generators.

Deep well pumps were not identified as a sound source by Marine Acoustics, Inc. (2011) during their acoustical testing of the *Spartan 151*, and are not considered an activity that would 'take' marine mammals.

4. Vertical Seismic Profiling

Once a well is drilled, accurate follow-up seismic data can be collected by placing a receiver at known depths in the borehole and shooting a seismic airgun at the surface near the borehole. These gathered data not only provide high resolution images of the geological layers penetrated by the borehole but can be used to accurately correlate (or correct) the original surface seismic data. The procedure is known as vertical seismic profiling (VSP).

BlueCrest intends to conduct VSP operations at the end of drilling each well using an array of airguns with total volumes of between 600 and 880 cubic inches (in³). The VSP operation is expected to last less than 1 or 2 days at each well site. Assuming a 1-meter source level of 227 dB re 1 μ Pa (based on manufacturer's specifications) for an 880 in³ array and using Collins *et al.*'s (2007) transmission loss model for Cook Inlet ($227 - 18.4 \text{ Log}(R) - 0.00188$), the 190 dB radius from the source was estimated at 330 ft (100 m), the 180 dB radius at 1,090 ft (332 m), and the 160 dB radius at 1.53 mi (2.46 km). 190 dB and 180 dB are the current NMFS thresholds for estimating Level A harassment from underwater noise exposure for pinnipeds and cetaceans, respectively, and 160 dB is the current NMFS threshold for estimating Level B harassment from exposure to underwater impulse noises. Therefore, VSP operations are considered an activity that has the potential to 'take' marine mammals.

Illingworth and Rodkin (2014) measured the underwater sound levels associated with a July 2013 VSP operation using a 750 in³ array and found sound levels exceeding 160 dB re 1 μ Pa (rms) extended out 1.54 mi (2.47 km), virtually identical to the modeled distance. The measured radius to 190 dB was 394 ft (120 m) and to 180 dB was 787 ft (240 m).

5. Helicopter and Supply Vessel Support

Helicopter logistics for project operations will include transportation for personnel,

groceries, and supplies. Helicopter support will consist of a twin turbine Bell 212 (or equivalent) helicopter certified for instrument flight rules land and over water operations. Helicopter crews and support personnel will be housed in existing Kenai area facilities. The helicopter will be based at the Kenai Airport to support rig crew changes and cargo handling. Fueling will take place at these facilities. No helicopter refueling will take place on the rig.

Helicopter flights to and from the rig are expected to average two per day. Flight routes will follow a direct route to and from the rig location, and flight heights will be maintained 1,000 to 1,500 feet above ground level to avoid take of marine mammals (Richardson *et al.*, 1995a). At these altitudes, there are not expected to be impacts from sound generation on marine mammals, and are not considered an activity that would ‘take’ marine mammals. The aircraft will be dedicated to the drilling operation and will be available for service 24 hours per day. A replacement aircraft will be available when major maintenance items are scheduled.

Major supplies will be staged on-shore at the Kenai OSK Dock. Required supplies and equipment will be moved from the staging area by contracted supply vessels and loaded aboard the rig when the rig is established on a drilling location. Major supplies will include fuel, drilling water, mud materials, cement, casing, and well service equipment. Supply vessels also will be outfitted with fire-fighting systems as part of fire prevention and control as required by Cook Inlet Spill Prevention and Response, Inc. The specific supply vessels have not been identified; however, typical offshore drilling support work vessels are of steel construction with strengthened hulls to give the capability of working in extreme conditions. Additional information about logistics and fuel and waste management can be found in Section 1.2 of BlueCrest’s IHA application.

Description of Marine Mammals in the Area of the Specified Activity

Several marine mammal species occur in lower Cook Inlet. The marine mammal species under NMFS's jurisdiction include: beluga whale (*Delphinapterus leucas*); harbor porpoise (*Phocoena phocoena*); killer whale (*Orcinus orca*); gray whale (*Eschrichtius robustus*); minke whale (*Balaenoptera acutorostrata*); Dall's porpoise (*Phocoenoides dalli*); humpback whale (*Megaptera novaeangliae*); harbor seal (*Phoca vitulina richardsi*); and Steller sea lion (*Eumetopias jubatus*).

Data collected during marine mammal monitoring at Cosmopolitan State #A-1 during summer 2013 recorded at least 154 harbor porpoise (152 within 1.2 mi (2 km) of operation, 12 of which were observed inside 853 ft (260 m) of the rig); 77 harbor seals (18 of these within 853 ft [260 m] of the active drill rig); 42 minke whales (all except for three recorded over 984 ft (300 m) from the active drill rig); 19 Dall's porpoise (none in close proximity to the active drill rig); 12 gray whales (observed offshore of Cape Starichkof; none closely approached drilling operations); seven Steller sea lions (none in close proximity to the active drill rig); 18 killer whales (17 within 1.2 mi (2 km) of operations); and one beluga whale (observed at a distance well beyond 1.8 mi (3 km) between May and August 2013 (112 days of monitoring). Based on their seasonal patterns, gray whales could be encountered in low numbers during operations. Minke whales have been considered migratory in Alaska (Allen and Angliss, 2014) but have recently been observed off Cape Starichkof and Anchor Point, including in winter. The remaining species could be encountered year-round. Humpback whales are common in the very southern part of Cook Inlet and typically do not venture north of Kachemak Bay (B. Mahoney, NMFS, pers. comm., August 2014), which is south of the proposed Cosmopolitan drilling site. Therefore, while it is unlikely that humpback whales, gray whales, or minke whales would be encountered during the proposed project, it is still a possibility based on observations from past

monitoring efforts, and therefore take of these species was requested.

Of these marine mammal species, Cook Inlet beluga whales, humpback whales, and the western distinct population segment (DPS) of Steller sea lions are listed as endangered under the Endangered Species Act (ESA). The eastern DPS of Steller sea lions was recently removed from the endangered species list (78 FR 66139, November 4, 2013) but currently retains its status as “depleted” under the MMPA along with the western DPS, Cook Inlet beluga whales, and humpback whales.

Despite these designations, Cook Inlet beluga whales and the western DPS of Steller sea lions have not made significant progress towards recovery. Data indicate that the Cook Inlet population of beluga whales decreased at a rate of 0.6 percent annually between 2002 and 2012 (Allen and Angliss, 2014). The NMFS 2014 Stock Assessment Report (SAR) estimated 312 Cook Inlet beluga whales, which is a three-year average. However, the most recent abundance estimate is 340 beluga whales (Shelden *et al.*, 2015).

Regional variation in trends in Western DPS Steller sea lion pup counts in 2000-2012 is similar to that of non-pup counts (Johnson and Fritz, 2014). Overall, there is strong evidence that pup counts in the western stock in Alaska increased (1.45 percent annually). Between 2004 and 2008, Alaska western non-pup counts increased only 3%: eastern Gulf of Alaska (Prince William Sound area) counts were higher and Kenai Peninsula through Kiska Island counts were stable, but western Aleutian counts continued to decline. Johnson and Fritz (2014) analyzed western Steller sea lion population trends in Alaska and noted that there was strong evidence that non-pup counts in the western stock in Alaska increased between 2000 and 2012 (average rate of 1.67 percent annually). However, there continues to be considerable regional variability in recent trends across the range in Alaska, with strong evidence of a positive trend east of Samalga Pass

and strong evidence of a decreasing trend to the west (Allen and Angliss, 2014).

The Central North Pacific humpback whale stock, consisting of winter/spring populations of the Hawaiian Islands which migrate primarily to northern British Columbia/Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands (Baker *et al.*, 1990; Perry *et al.*, 1990; Calambokidis *et al.*, 1997), has increased over the past two decades. Different studies and sampling techniques in Hawaii and Alaska have indicated growth rates ranging from 4.9-10 percent per year in the 1980s, 1990s, and early 2000s (Mobley *et al.*, 2001; Mizroch *et al.*, 2004; Zerbini *et al.*, 2006; Calambokidis *et al.*, 2008). It is also clear that the abundance has increased in Southeast Alaska, though a trend for the Southeast Alaska portion of this stock cannot be estimated from the data because of differences in methods and areas covered (Allen and Angliss, 2013). On April 21, 2015, NMFS published a notice in the **Federal Register** requesting comments on a proposal to revise the listing status of humpback whales by delineating the species into 14 DPS, changing the Central North Pacific stock of humpback whales to become the Hawaii DPS. NMFS also proposed to delist the Hawaii DPS (80 FR 22304).

Pursuant to the ESA, critical habitat has been designated for Cook Inlet beluga whales and Steller sea lions. The proposed drilling program does not fall within critical habitat designated in Cook Inlet for beluga whales or within critical habitat designated for Steller sea lions. The Cosmopolitan State unit is nearly 100 miles south of beluga whale Critical Habitat Area 1 and approximately 27 miles south of Critical Habitat Area 2. It is also located about 25 miles north of the isolated patch of Critical Habitat Area 2 found in Kachemak Bay. Area 2 is based on dispersed fall and winter feeding and transit areas in waters where whales typically appear in smaller densities or deeper waters (76 FR 20180, April 11, 2011). No critical habitat has been designated for humpback whales.

BlueCrest is requesting take of belugas, humpback whales and Steller sea lions, which have been observed in close proximity to the Cosmopolitan site (G. Green, Owl Ridge, personal communication). In addition, BlueCrest is requesting take of gray, minke, and killer whales, harbor and Dall's porpoise, and harbor seals. See Table 1 below for more information on the habitat, range, population, and status of these species.

Table 1. The Habitat, Abundance, and Conservation Status of Marine Mammals.

Species	Habitat	Range	Best Population Estimate (Minimum) ¹	ESA ²	MMPA ³
Humpback whale (<i>Megaptera novaeangliae</i>)	Coastal and inland waters	Worldwide in all ocean basins	10,103 – Central N. Pacific Stock	EN	D, S
Minke Whale (<i>Balaenoptera acutorostr</i>)	Coastal and inland waters	Bering and Chukchi Seas south to near the Equator	1,233 ² - Alaska stock	NL	NC
Gray Whale (<i>Eschrichtius robustus</i>)	Coastal and inland waters	North Pacific from Alaska to Mexico	20,990 ³ – E. North Pacific Stock	NL	NC
Beluga Whale (<i>Delphinapterus leucas</i>)	Offshore waters in winter; coastal/estuarine waters in spring	Ice-covered arctic and subarctic waters of the Northern Hemisphere.	340 – Cook Inlet stock	EN	D, S
Killer Whale (<i>Orcinus orca</i>)	Offshore to inland waterways	Throughout North Pacific; along west coast of North America; entire Alaskan coast	2,347 – Alaska resident stock/ 587 Alaska transient stock	NL	NC
Harbor Porpoise (<i>Phocoena phocoena</i>)	Coastal	Point Barrow, Alaska to Point Conception, California	31,046 – Gulf of Alaska stock	NL	S
Dall's Porpoise (<i>Phocoenoides dalli</i>)	Over continental shelf adjacent to slope and over deep oceanic waters	Throughout North Pacific	83,400 – Alaska stock	NL	NC

Pacific harbor seal (<i>Phoca vitulina richardii</i>)	Coastal and Estuarine	Coastal temperate to polar regions in Northern Hemisphere	22,900 – Cook Inlet/Shelikof stock	NL	NC
Steller Sea Lion (<i>Eumetopias jubatus</i>)	Coastal	Northern Pacific Rim from northern Japan to California	55,422 – W. US stock	NL	D, S

NA = Not available or not assessed.

¹ Allen and Angliss (2015)

² Zerbini *et al.* (2006)

³ Caretta *et al.* (2015)

⁴ U.S. Endangered Species Act: EN = Endangered, T = Threatened, DL = Delisted, and NL = Not listed.

⁵ U.S. Marine Mammal Protection Act: D = Depleted, S = Strategic, and NC = Not classified.

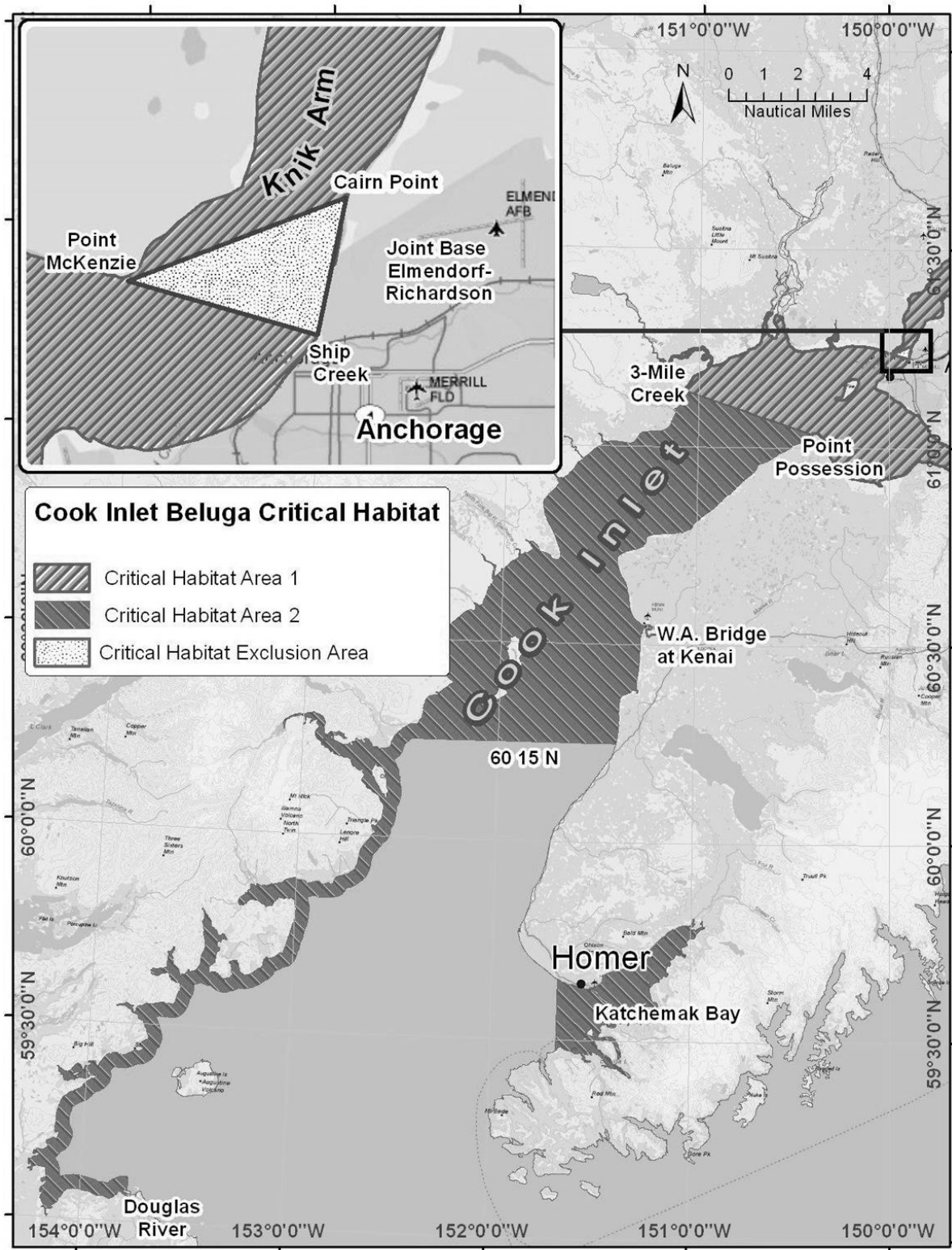
Cetaceans

Beluga Whale (*Delphinapterus leucas*)

The Cook Inlet beluga whale DPS is a small geographically isolated population that is separated from other beluga populations by the Alaska Peninsula. The population is genetically (mtDNA) distinct from other Alaska populations suggesting the Peninsula is an effective barrier to genetic exchange (O’Corry-Crowe *et al.* 1997) and that these whales may have been separated from other stocks at least since the last ice age. Laidre *et al.* (2000) examined data from more than 20 marine mammal surveys conducted in the northern Gulf of Alaska and found that sightings of belugas outside Cook Inlet were exceedingly rare, and these were composed of a few stragglers from the Cook Inlet DPS observed at Kodiak Island, Prince William Sound, and Yakutat Bay. Several marine mammal surveys specific to Cook Inlet (Laidre *et al.* 2000, Speckman and Piatt 2000), including those that concentrated on beluga whales (Rugh *et al.* 2000, 2005a), clearly indicate that this stock largely confines itself to Cook Inlet. There is no indication that these whales make forays into the Bering Sea where they might intermix with other Alaskan stocks.

The Cook Inlet beluga DPS was originally estimated at 1,300 whales in 1979 (Calkins 1989) and has been the focus of management concerns since experiencing a dramatic decline in the 1990s. Between 1994 and 1998 the stock declined 47 percent which was attributed to overharvesting by subsistence hunting. Subsistence hunting was estimated to annually remove 10 to 15 percent of the population during this period. Only five belugas have been harvested since 1999, yet the population has continued to decline, with the most recent estimate at only 312 animals (Allen and Angliss 2014). NMFS listed the population as “depleted” in 2000 as a consequence of the decline, and as “endangered” under the Endangered Species Act (ESA) in 2008 when the population failed to recover following a moratorium on subsistence harvest. In April 2011, NMFS designated critical habitat for the beluga under the ESA (Figure 1).

Figure 1. Cook Inlet Beluga Critical Habitat.



Prior to the decline, this DPS was believed to range throughout Cook Inlet and occasionally into Prince William Sound and Yakutat (Nemeth *et al.* 2007). However the range has contracted coincident with the population reduction (Speckman and Piatt 2000). During the summer and fall beluga whales are concentrated near the Susitna River mouth, Knik Arm, Turnagain Arm, and Chickaloon Bay (Nemeth *et al.* 2007) where they feed on migrating eulachon (*Thaleichthys pacificus*) and salmon (*Onchorhynchus spp.*) (Moore *et al.* 2000). Critical Habitat Area 1 reflects this summer distribution (Figure 1). During the winter, beluga whales concentrate in deeper waters in the mid-inlet to Kalgin Island, and in the shallow waters along the west shore of Cook Inlet to Kamishak Bay (Critical Habitat Area 2; Figure 1). Some whales may also winter in and near Kachemak Bay.

The Cosmopolitan State lease does not fall within beluga whale critical habitat. Based on Goetz *et al.* (2012) beluga whale densities, both along the route from Port Graham and at the well site, are very low (<0.01 whales/km²). In the past, beluga whales have been observed in Kachemak Bay, which presumably could have travelled between the bay and upper Cook Inlet following a route past the current location of the Cosmopolitan State lease. Reported observations since 1975 show most whale activity in Kachemak Bay occurred prior to 2000. However, in 2013 a single beluga was sighted a few kilometers from Cosmopolitan State well site #A-1 (Owl Ridge 2014).

Killer Whales (*Orcinus orca*)

Two different killer whale stocks inhabit the Cook Inlet region of Alaska: the Alaska resident stock (resident stock) and the Gulf of Alaska, Aleutian Islands, Bering Sea transient stock (transient stock) (Allen and Angliss, 2014). The Alaska resident stock occurs from Southeast Alaska to the Bering Sea (Allen and Angliss, 2014) and feeds exclusively on fish,

while transient killer whales feed primarily on marine mammals (Saulitis *et al.*, 2000). Killer whales are occasionally observed in lower Cook Inlet, especially near Homer and Port Graham (Shelden *et al.*, 2003; Rugh *et al.*, 2005). A concentration of sightings near Homer and inside Kachemak Bay may represent high killer whale use or high observer-effort given most records are from a whale-watching venture based in Homer. During aerial surveys conducted between 1993 and 2004, killer whales were only observed on three flights, all in the Kachemak Bay and English Bay area (Rugh *et al.*, 2005). Eighteen killer whales (it is unknown which stock these belonged to) were recorded during the May to August 2013 marine mammal monitoring activities at Cosmopolitan State #A-1 (Owl Ridge 2014). Based on these sightings, it is possible that killer whales will occur in the vicinity of the proposed drilling activity.

Harbor Porpoise (*Phocoena phocoena*)

The most recent estimated density for harbor porpoises in Cook Inlet is 7.2 per 1,000 km² (Dahlheim *et al.*, 2000) indicating that only a small number use Cook Inlet. Harbor porpoise have been reported in lower Cook Inlet from Cape Douglas to the West Foreland, Kachemak Bay, and offshore (Rugh *et al.*, 2005). Harbor porpoises are found primarily in coastal waters less than 328 ft deep (Hobbs and Waite, 2010) where they feed primarily on Pacific herring, other schooling fish, and cephalopods. The diet of harbor porpoise within Cook Inlet is unknown, although seasonal distribution patterns of porpoise (Shelden *et al.* 2014) coincident with eulachon, longfin smelt, capelin, herring, and salmon concentrations (Moulton 1997) suggest these fish are important prey items for Cook Inlet harbor porpoise. Small numbers of harbor porpoises have been consistently reported in upper Cook Inlet between April and October, except for a recent survey that recorded higher than usual numbers (Prevel Ramos *et al.*, 2008). In addition, recent passive acoustic research in Cook Inlet by the Alaska Department of Fish and

Game and the National Marine Mammal Laboratory (NMML) have indicated that harbor porpoises occur more frequently than previously thought, particularly in the West Foreland area in the spring (NMML, 2011); however overall numbers are still unknown at this time. Also, harbor porpoises were the most frequently sighted marine mammal species during monitoring in 2013 at the Cosmopolitan State #A-1 well. At least 154 harbor porpoises were recorded during the 2013 monitoring, but only 12 were observed inside 853 ft (260 m) of the drill rig.

Humpback whale (*Megaptera novaeangliae*)

Although there is considerable distributional overlap in the humpback whale stocks that use Alaska, the whales seasonally found in lower Cook Inlet are probably of the Central North Pacific stock. Listed as endangered under the Endangered Species Act (ESA), this stock has recently been estimated at 7,469, with the portion of the stock that feeds in the Gulf of Alaska estimated at 2,845 animals (Allen and Angliss 2014). The Central North Pacific stock winters in Hawaii and summers from British Columbia to the Aleutian Islands (Calambokidis *et al.* 1997), including Cook Inlet.

In the North Pacific, humpback whales feed primarily on krill (especially euphausiids) and small schooling fish such including herring, sand lance, capelin, and eulachon (Clapham 2002). Based on both fecal samples and isotope analysis, Witteveen *et al.* (2011) found humpback whales near Kodiak Island to feed largely on euphausiids, capelin, Pacific sand lance, and juvenile walleye pollock. It is unknown what humpback whales seasonally occurring in Kachemak Bay and near Anchor Point are feeding on, but Cook Inlet seabird and forage fish studies (Piatt and Roseneau 1997) found large concentrations of sand lance in this region. Humpback use of Cook Inlet is largely confined to lower Cook Inlet. They have been regularly seen near Kachemak Bay during the summer months (Rugh *et al.* 2005a), and there is a whale-

watching venture in Homer capitalizing on this seasonal event. There are anecdotal observations of humpback whales as far north as Anchor Point, with very few records to the latitude of the Cosmopolitan State lease area. However, 29 sightings of 48 humpback whales were recorded by marine mammal observers during the 2013 monitoring program at Cosmopolitan State well site #A-1 (Owl Ridge 2014), although nearly all of these animals were observed at a distance well south of the well site, many records were repeat sightings of the same animals, and none were recorded inside an active harassment zone. Due to these sightings, humpback whales may be encountered in the vicinity of the project and were included in the application for incidental take.

Gray Whale (*Eschrichtius robustus*)

The gray whale is a large baleen whale known to have one of the longest migrations of any mammal. This whale can be found all along the shallow coastal waters of the North Pacific Ocean. The Eastern North Pacific stock, which includes those whales that travel along the coast of Alaska, was delisted from the ESA in 1994 after a distinction was made between the western and eastern populations (59 FR 31094, June 16, 1994). The most recent estimate of abundance for the Eastern North Pacific stock of gray whales is 19,126, based on the 2006/2007 southbound survey (Laake *et al.*, 2009).

Gray whales typically do not feed during their northward migration through Alaskan waters until they reach the Chukchi Sea where they spend the summer feeding mostly on amphipods, a benthic crustacean (Rice and Wolman 1971, Highsmith and Coyle 1992, Nelson *et al.* 1994). However, small groups of whales may opportunistically feed along route (Nerini 1984), with some groups actually becoming “resident” at areas of high localized prey densities (Calambokidis *et al.* 2004, Estes 2006). One “resident” group, known as the Kodiak group, has been observed year-round at Ugak Bay (Kodiak Island) feeding on dense

populations of hooded shrimp or cumaceans (Diastylidae), a benthic crustacean (Moore et al. 2007). Groups of gray whales were recorded at the Cosmopolitan State lease site in 2013 (Owl Ridge 2014), mostly in July, but it was noted that these may have been repeated sightings of the same one or two small groups, suggesting seasonal foraging use of the Anchor Point area by a few whales. There is no information the diet of gray whales using lower Cook Inlet, but available prey could be similar to that found at Ugak Bay.

Although observations of gray whales are rare within Cook Inlet, marine mammal observers noted individual gray whales on nine occasions in upper Cook Inlet in 2012 while conducting marine mammal monitoring for seismic survey activities under an IHA NMFS issued to Apache Alaska Corporation: four times in May; twice in June; and three times in July (Apache, 2013). Annual surveys conducted by NMFS in Cook Inlet since 1993 have resulted in a total of five gray whale sightings (Rugh *et al.*, 2005). Although Cook Inlet is not believed to comprise either essential feeding or social ground, there may be some encounters in lower Cook Inlet. Small numbers of summering gray whales have been noted by fishermen near Kachemak Bay and north of Anchor Point. Further, summer gray whales were recorded a dozen times offshore of Cape Starichkof by observers monitoring BlueCrest's Cosmopolitan #A-1 drilling program between May and August 2013. However, as noted above, these may have been repeat sightings of the same one or two small groups.

Minke Whale (*Balaenoptera acutorostrata*)

Minke whales are the smallest of the rorqual group of baleen whales. There are no population estimates for the North Pacific, although estimates have been made for some portions of Alaska. Zerbini *et al.* (2006) estimated the coastal population between Kenai Fjords and the Aleutian Islands at 1,233 animals. During Cook Inlet-wide aerial surveys conducted from 1993

to 2004, minke whales were encountered only twice (1998, 1999), both times off Anchor Point 16 mi northwest of Homer. A minke whale was also reported off Cape Starichkof in 2011 (A. Holmes, pers. comm.) and 2013 (E. Fernandez and C. Hesselbach, pers. comm.), suggesting this location is regularly used by minke whales, including during the winter. There are no records north of Cape Starichkof. However, 42 minke whales were recorded at Cosmopolitan State site #A-1 between May and August 2013 in patterns suggesting the presence of a small, yet conspicuous summer population (at least) within the Cosmopolitan State unit. All but three of the minke whales observed during the 2013 monitoring season were recorded over 984 ft (300 m) from the active drill rig.

Minke whales have a very catholic diet feeding on preferred prey most abundant at a given time and location (Leatherwood and Reeves 1983). In the southern hemisphere they feed largely on krill, while in the North Pacific they feed on schooling fish such as herring, sandlance, and walleye pollock (Reeves et al. 2002). There is no dietary information specific to Alaska although anecdotal observations of minke whales feeding on shoaling fish off Anchor Point have been reported to NMFS (Brad Smith, pers. comm.).

Dall's Porpoise (*Phocoenoides dalli*)

Dall's porpoise are widely distributed throughout the North Pacific Ocean including Alaska, although they are not found in upper Cook Inlet and the shallower waters of the Bering, Chukchi, and Beaufort Seas (Allen and Angliss, 2014). The Alaskan population has been estimated at 83,400 animals (Allen and Angliss, 2014), making it one of the more common cetaceans in the state. Dall's porpoise prefer the deep offshore and shelf slope waters where they feed largely on mesopelagic fish and squid, but also herring in more nearshore waters (Jefferson 2002). There is no diet information specific to Cook Inlet. Dall's porpoise have been observed in

lower Cook Inlet, including Kachemak Bay and near Anchor Point (Glenn Johnson, pers. comm.), but sightings there are rare, as expected, given they prefer waters exceeding 180 meters deep. During 112 days of monitoring during the Cosmopolitan State #1 drilling operation between May and August 2013, 19 Dall's porpoise were recorded (all during the month of August), but none were observed in close proximity of the drill rig (*i.e.*, they were greater than 853 ft [260 m away]).

Pinnipeds

Harbor Seals (*Phoca vitulina*)

Harbor seals inhabit the coastal and estuarine waters of Cook Inlet and are one of the more common marine mammal species in Alaskan waters. Harbor seals are non-migratory; their movements are associated with tides, weather, season, food availability, and reproduction. The major haulout sites for harbor seals are located in lower Cook Inlet, and their presence in the upper inlet coincides with seasonal runs of prey species. For example, harbor seals are commonly observed along the Susitna River and other tributaries along upper Cook Inlet during the eulachon and salmon migrations (NMFS, 2003). During aerial surveys of upper Cook Inlet in 2001, 2002, and 2003, harbor seals were observed 24 to 96 km (15 to 60 mi) south-southwest of Anchorage at the Chickaloon, Little Susitna, Susitna, Ivan, McArthur, and Beluga Rivers (Rugh *et al.*, 2005). Montgomery *et al.* (2007) recorded over 200 haulout sites in lower Cook Inlet alone. Montgomery *et al.* (2007) also found seals elsewhere in Cook Inlet to move in response to local steelhead and salmon runs. However, aerial surveys conducted in June 2013 for the proposed Susitna Dam project noted nearly 700 harbor seals in the Susitna Delta region (Alaska Energy Authority, 2013). During the marine mammal monitoring associated with the 2013 drilling activities at Cosmopolitan State, 77 harbor seals were recorded. Harbor seals may be

encountered during BlueCrest's lower Cook Inlet proposed drilling program.

Steller sea lion (*Eumetopias jubatus*)

The Western Stock of the Steller sea lion is defined as all populations west of longitude 144°W to the western end of the Aleutian Islands. The most recent estimate for this stock is 45,649 animals (Allen and Angliss 2014), considerably less than that estimated 140,000 animals in the 1950s (Merrick *et al.* 1987). Because of this dramatic decline, the stock was listed as threatened under ESA in 1990, and was relisted as endangered in 1997. Critical habitat was designated in 1993, and is defined as a 20-nautical-mile radius around all major rookeries and haulout sites. The 20-nautical-mile buffer was established based on telemetry data that indicated these sea lions concentrated their summer foraging effort within this distance of rookeries and haul outs.

Steller sea lions inhabit lower Cook Inlet, especially in the vicinity of Shaw Island and Elizabeth Island (Nagahut Rocks) haulout sites (Rugh *et al.* 2005a), but are rarely seen in upper Cook Inlet (Nemeth *et al.* 2007). Of the 42 Steller sea lion groups recorded during Cook Inlet aerial surveys between 1993 and 2004, none were recorded north of Anchor Point and only one in the vicinity of Kachemak Bay (Rugh *et al.* 2005a). Marine mammal observers associated with Buccaneer's drilling project off Cape Starichkof did observe seven Steller sea lions during the summer of 2013 (Owl Ridge 2014).

The upper reaches of Cook Inlet may not provide adequate foraging conditions for sea lions for establishing a major haul out presence. Steller sea lions feed largely on walleye pollock (*Theragra chalcogramma*), salmon (*Onchorhyncus spp.*), and arrowtooth flounder (*Atheresthes stomias*) during the summer, and walleye pollock and Pacific cod (*Gadus macrocephalus*) during the winter (Sinclair and Zeppelin 2002), none which, except for salmon, are found in abundance

in upper Cook Inlet (Nemeth *et al.* 2007). Small numbers of Steller sea lions are likely to be encountered during BlueCrest's planned operations in 2016 based on the observations of sea lions made at the lease site in 2013 (Owl Ridge 2014), but on of which was observed within 50m of the drill rig during the 2013 monitoring program.

Summary

BlueCrest's application contains information on the status, distribution, seasonal distribution, and abundance of each of the species under NMFS jurisdiction mentioned in this document. Please refer to the application for that information (see ADDRESSES). Additional information can also be found in the NMFS Stock Assessment Reports (SAR). The Alaska 2014 SAR is available on the Internet at: http://www.nmfs.noaa.gov/pr/sars/pdf/ak2014_final.pdf.

Potential Effects of the Specified Activity on Marine Mammals

This section includes a summary and discussion of the ways that the types of stressors associated with the specified activity (e.g., impact hammering of the drive pipe and VSP) has been observed to, or are thought to, impact marine mammals. The "Estimated Take by Incidental Harassment" section later in this document will include a quantitative analysis of the number of individuals that are expected to be taken by this activity. The "Negligible Impact Analysis" section will include the analysis of how this specific activity will impact marine mammals and will consider the content of this section, the "Estimated Take by Incidental Harassment" section, the "Mitigation" section, and the "Anticipated Effects on Marine Mammal Habitat" section to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks.

The likely or possible impacts of the proposed drilling program in lower Cook Inlet on marine mammals could involve both non-acoustic and acoustic stressors. Potential non-acoustic

stressors include the physical presence of the equipment and personnel. Petroleum development and associated activities introduce sound into the marine environment. Impacts to marine mammals are expected to primarily be acoustic in nature. Potential acoustic effects on marine mammals relate to impact hammering of drive pipe and the VSP airgun array.

Acoustic Impacts

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms have been derived using auditory evoked potentials, anatomical modeling, and other data, Southall *et al.* (2007) designate “functional hearing groups” for marine mammals and estimate the lower and upper frequencies of functional hearing of the groups. The functional groups and the associated frequencies are indicated below (though animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

- Low frequency cetaceans (13 species of mysticetes): functional hearing is estimated to occur between approximately 7 Hz and 25 kHz;
- Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High frequency cetaceans (eight species of true porpoises, six species of river dolphins, Kogia, the franciscana, and four species of cephalorhynchids): functional hearing is estimated to occur between approximately 200 Hz and 180 kHz;
- Phocid pinnipeds in Water: functional hearing is estimated to occur between

approximately 75 Hz and 100 kHz; and

- Otariid pinnipeds in Water: functional hearing is estimated to occur between approximately 100 Hz and 48 kHz.

As mentioned previously in this document, nine marine mammal species (seven cetacean and two pinniped species) may occur in the drilling area of BlueCrest's lower Cook Inlet project. Of the seven cetacean species likely to occur in the proposed project area and for which take is requested, three are classified as low-frequency cetaceans (i.e., humpback, minke, and gray whales), two are classified as a mid-frequency cetacean (i.e., beluga and killer whales), and two are classified as high-frequency cetaceans (i.e., harbor and Dall's porpoises) (Southall *et al.*, 2007). A species' functional hearing group is a consideration when we analyze the effects of exposure to sound on marine mammals.

1. Tolerance

Numerous studies have shown that underwater sounds from industry activities are often readily detectable by marine mammals in the water at distances of many kilometers. Numerous studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response to industry activities of various types (Miller *et al.*, 2005; Bain and Williams, 2006). This is often true even in cases when the sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to underwater sound such as airgun pulses or vessels under some conditions, at other times mammals of all three types have shown no overt reactions (e.g., Malme *et al.*, 1986; Richardson *et al.*, 1995a; Madsen and Mohl, 2000; Croll *et al.*, 2001; Jacobs and Terhune, 2002; Madsen *et al.*, 2002; Miller *et al.*, 2005). Weir (2008) observed marine mammal

responses to seismic pulses from a 24 airgun array firing a total volume of either 5,085 in³ or 3,147 in³ in Angolan waters between August 2004 and May 2005. Weir recorded a total of 207 sightings of humpback whales (n = 66), sperm whales (n = 124), and Atlantic spotted dolphins (n = 17) and reported that there were no significant differences in encounter rates (sightings/hr) for humpback and sperm whales according to the airgun array's operational status (i.e., active versus silent). The airgun arrays used in the Weir (2008) study were much larger than the array proposed for use during the limited VSP (total discharge volumes of 600 to 880 in³ for 1 to 2 days). In general, pinnipeds and small odontocetes seem to be more tolerant of exposure to some types of underwater sound than are baleen whales. Richardson *et al.* (1995a) found that vessel noise does not seem to strongly affect pinnipeds that are already in the water. Richardson *et al.* (1995a) went on to explain that seals on haul-outs sometimes respond strongly to the presence of vessels and at other times appear to show considerable tolerance of vessels.

2. Masking

Masking is the obscuring of sounds of interest by other sounds, often at similar frequencies. Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, avoiding predators, and learning about their environment (Erbe and Farmer, 2000; Tyack, 2000). Masking, or auditory interference, generally occurs when sounds in the environment are louder than, and of a similar frequency as, auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals that are trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations in situations where the

temporal and spatial scope of the masking activities is extensive.

Masking occurs when anthropogenic sounds and signals (that the animal utilizes) overlap at both spectral and temporal scales. The sounds generated by the proposed equipment for the drilling program will consist of low frequency sources (most under 500 Hz). Lower frequency man-made sounds are more likely to affect detection of communication calls of low-frequency specialists and other potentially important natural sounds such as surf and prey noise. There is less concern regarding masking of conspecific vocalizations near the jack-up rig during drilling operations, as the species most likely to be found in the vicinity are mid- to high-frequency cetaceans or pinnipeds and not low-frequency cetaceans. Additionally, masking is not expected to be a concern from airgun usage due to the brief duration of use (less than a day to up to 2 days) and the low-frequency sounds that are produced by the airguns. However, at long distances (over tens of kilometers away), due to multipath propagation and reverberation, the durations of airgun pulses can be “stretched” to seconds with long decays (Madsen *et al.*, 2006), although the intensity of the sound is greatly reduced.

The “stretching” of sound described above could affect communication signals used by low frequency mysticetes when they occur near the noise band and thus reduce the communication space of animals (e.g., Clark *et al.*, 2009) and cause increased stress levels (e.g., Foote *et al.*, 2004; Holt *et al.*, 2009); however, only low numbers of baleen whales are expected to occur within the proposed action area. Marine mammals are thought to sometimes be able to compensate for masking by adjusting their acoustic behavior by shifting call frequencies, and/or increasing call volume and vocalization rates. For example, blue whales are found to increase call rates when exposed to seismic survey noise in the St. Lawrence Estuary (Di Iorio and Clark, 2010). The North Atlantic right whales (*Eubalaena glacialis*) exposed to high shipping noise

increase call frequency (Parks *et al.*, 2007), while some humpback whales respond to low-frequency active sonar playbacks by increasing song length (Miller *et al.*, 2000). Additionally, beluga whales have been known to change their vocalizations in the presence of high background noise possibly to avoid masking calls (Au *et al.*, 1985; Lesage *et al.*, 1999; Scheifele *et al.*, 2005). Although some degree of masking is inevitable when high levels of manmade broadband sounds are introduced into the sea, marine mammals have evolved systems and behavior that function to reduce the impacts of masking. Structured signals, such as the echolocation click sequences of small toothed whales, may be readily detected even in the presence of strong background noise because their frequency content and temporal features usually differ strongly from those of the background noise (Au and Moore, 1988, 1990). The components of background noise that are similar in frequency to the sound signal in question primarily determine the degree of masking of that signal.

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The sound localization abilities of marine mammals suggest that, if signal and noise come from different directions, masking would not be as severe as the usual types of masking studies might suggest (Richardson *et al.*, 1995a). The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio. In the cases of higher frequency hearing by the bottlenose dolphin, beluga whale, and killer whale, empirical evidence confirms that masking depends strongly on the relative directions of arrival of sound signals and the masking noise

(Penner *et al.*, 1986; Dubrovskiy, 1990; Bain *et al.*, 1993; Bain and Dahlheim, 1994). Toothed whales, and probably other marine mammals as well, have additional capabilities besides directional hearing that can facilitate detection of sounds in the presence of background noise. There is evidence that some toothed whales can shift the dominant frequencies of their echolocation signals from a frequency range with a lot of ambient noise toward frequencies with less noise (Au *et al.*, 1974, 1985; Moore and Pawloski, 1990; Thomas and Turl, 1990; Romanenko and Kitain, 1992; Lesage *et al.*, 1999). A few marine mammal species are known to increase the source levels or alter the frequency of their calls in the presence of elevated sound levels (Dahlheim, 1987; Au, 1993; Lesage *et al.*, 1993, 1999; Terhune, 1999; Foote *et al.*, 2004; Parks *et al.*, 2007, 2009; Di Iorio and Clark, 2009; Holt *et al.*, 2009).

These data demonstrating adaptations for reduced masking pertain mainly to the very high frequency echolocation signals of toothed whales. There is less information about the existence of corresponding mechanisms at moderate or low frequencies or in other types of marine mammals. For example, Zaitseva *et al.* (1980) found that, for the bottlenose dolphin, the angular separation between a sound source and a masking noise source had little effect on the degree of masking when the sound frequency was 18 kHz, in contrast to the pronounced effect at higher frequencies. Directional hearing has been demonstrated at frequencies as low as 0.5-2 kHz in several marine mammals, including killer whales (Richardson *et al.*, 1995a). This ability may be useful in reducing masking at these frequencies. In summary, high levels of sound generated by anthropogenic activities may act to mask the detection of weaker biologically important sounds by some marine mammals. This masking may be more prominent for lower frequencies. For higher frequencies, such as that used in echolocation by toothed whales, several mechanisms are available that may allow them to reduce the effects of such masking.

3. Behavioral Disturbance

Behavioral responses to sound are highly variable and context-specific. Many different variables can influence an animal's perception of and response to (in both nature and magnitude) an acoustic event. An animal's prior experience with a sound or sound source affects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future (animals can also be innately pre-disposed to respond to certain sounds in certain ways; Southall *et al.*, 2007). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), similarity of a sound to biologically relevant sounds in the animal's environment (i.e., calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.*, 2007). Individuals (of different age, gender, reproductive status, etc.) among most populations will have variable hearing capabilities and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (i.e., proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone.

Exposure of marine mammals to sound sources can result in (but is not limited to) no response or any of the following observable responses: increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; avoidance; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.*, 2007). The biological significance of many of these behavioral

disturbances is difficult to predict.

The following sub-sections provide examples of the variability in behavioral responses that could be expected given the different sensitivities of marine mammal species to sound.

Baleen Whales—Richardson *et al.* (1995b) reported changes in surfacing and respiration behavior and the occurrence of turns during surfacing in bowhead whales exposed to playback of underwater sound from drilling activities. These behavioral effects were localized and occurred at distances up to 1.2-2.5 mi (2-4 km).

Richardson *et al.* (2008) reported a slight change in the distribution of bowhead whale calls in response to operational sounds on BP's Northstar Island. The southern edge of the call distribution ranged from 0.47 to 1.46 mi (0.76 to 2.35 km) farther offshore, apparently in response to industrial sound levels. However, this result was only achieved after intensive statistical analyses, and it is not clear that this represented a biologically significant effect.

Richardson *et al.* (1995a) and Moore and Clarke (2002) reviewed a few studies that observed responses of gray whales to aircraft. Cow-calf pairs were quite sensitive to a turboprop survey flown at 1,000 ft (305 m) altitude on the Alaskan summering grounds. In that survey, adults were seen swimming over the calf, or the calf swam under the adult (Ljungblad *et al.*, 1983, cited in Richardson *et al.*, 1995a and Moore and Clarke, 2002). However, when the same aircraft circled for more than 10 minutes at 1,050 ft (320 m) altitude over a group of mating gray whales, no reactions were observed (Ljungblad *et al.*, 1987, cited in Moore and Clarke, 2002). Malme *et al.* (1984, cited in Richardson *et al.*, 1995a and Moore and Clarke, 2002) conducted playback experiments on migrating gray whales. They exposed the animals to underwater noise recorded from a Bell 212 helicopter (estimated altitude=328 ft [100 m]), at an average of three simulated passes per minute. The authors observed that whales changed their swimming course

and sometimes slowed down in response to the playback sound but proceeded to migrate past the transducer. Migrating gray whales did not react overtly to a Bell 212 helicopter at greater than 1,394 ft (425 m) altitude, occasionally reacted when the helicopter was at 1,000-1,198 ft (305-365 m), and usually reacted when it was below 825 ft (250 m; Southwest Research Associates, 1988, cited in Richardson *et al.*, 1995a and Moore and Clarke, 2002). Reactions noted in that study included abrupt turns or dives or both. Green *et al.* (1992, cited in Richardson *et al.*, 1995a) observed that migrating gray whales rarely exhibited noticeable reactions to a straight-line overflight by a Twin Otter at 197 ft (60 m) altitude. Overflights are likely to have little or no disturbance effects on baleen whales. Any disturbance that may occur would likely be temporary and localized.

Southall *et al.* (2007, Appendix C) reviewed a number of papers describing the responses of marine mammals to non-pulsed sound, such as that produced during drilling operations. In general, little or no response was observed in animals exposed at received levels from 90-120 dB re 1 μ Pa (rms). Probability of avoidance and other behavioral effects increased when received levels were from 120-160 dB re 1 μ Pa (rms). Some of the relevant reviews contained in Southall *et al.* (2007) are summarized next.

Baker *et al.* (1982) reported some avoidance by humpback whales to vessel noise when received levels were 110-120 dB (rms) and clear avoidance at 120-140 dB (sound measurements were not provided by Baker but were based on measurements of identical vessels by Miles and Malme, 1983).

Malme *et al.* (1983, 1984) used playbacks of sounds from helicopter overflight and drilling rigs and platforms to study behavioral effects on migrating gray whales. Received levels exceeding 120 dB induced avoidance reactions. Malme *et al.* (1984) calculated 10%, 50%, and

90% probabilities of gray whale avoidance reactions at received levels of 110, 120, and 130 dB, respectively. Malme *et al.* (1986) observed the behavior of feeding gray whales during four experimental playbacks of drilling sounds (50 to 315 Hz; 21-min overall duration and 10% duty cycle; source levels of 156-162 dB). In two cases for received levels of 100-110 dB, no behavioral reaction was observed. However, avoidance behavior was observed in two cases where received levels were 110-120 dB.

Richardson *et al.* (1990) performed 12 playback experiments in which bowhead whales in the Alaskan Arctic were exposed to drilling sounds. Whales generally did not respond to exposures in the 100 to 130 dB range, although there was some indication of minor behavioral changes in several instances.

McCauley *et al.* (1996) reported several cases of humpback whales responding to vessels in Hervey Bay, Australia. Results indicated clear avoidance at received levels between 118 to 124 dB in three cases for which response and received levels were observed/measured.

Palka and Hammond (2001) analyzed line transect census data in which the orientation and distance off transect line were reported for large numbers of minke whales. The authors developed a method to account for effects of animal movement in response to sighting platforms. Minor changes in locomotion speed, direction, and/or diving profile were reported at ranges from 1,847 to 2,352 ft (563 to 717 m) at received levels of 110 to 120 dB.

Biassoni *et al.* (2000) and Miller *et al.* (2000) reported behavioral observations for humpback whales exposed to a low-frequency sonar stimulus (160- to 330-Hz frequency band; 42-s tonal signal repeated every 6 min; source levels 170 to 200 dB) during playback experiments. Exposure to measured received levels ranging from 120 to 150 dB resulted in variability in humpback singing behavior. Croll *et al.* (2001) investigated responses of foraging

fin and blue whales to the same low frequency active sonar stimulus off southern California. Playbacks and control intervals with no transmission were used to investigate behavior and distribution on time scales of several weeks and spatial scales of tens of kilometers. The general conclusion was that whales remained feeding within a region for which 12 to 30 percent of exposures exceeded 140 dB.

Frankel and Clark (1998) conducted playback experiments with wintering humpback whales using a single speaker producing a low-frequency “M-sequence” (sine wave with multiple-phase reversals) signal in the 60 to 90 Hz band with output of 172 dB at 1 m. For 11 playbacks, exposures were between 120 and 130 dB re 1 μ Pa (rms) and included sufficient information regarding individual responses. During eight of the trials, there were no measurable differences in tracks or bearings relative to control conditions, whereas on three occasions, whales either moved slightly away from ($n = 1$) or towards ($n = 2$) the playback speaker during exposure. The presence of the source vessel itself had a greater effect than did the M-sequence playback.

Finally, Nowacek *et al.* (2004) used controlled exposures to demonstrate behavioral reactions of northern right whales to various non-pulse sounds. Playback stimuli included ship noise, social sounds of conspecifics, and a complex, 18-min “alert” sound consisting of repetitions of three different artificial signals. Ten whales were tagged with calibrated instruments that measured received sound characteristics and concurrent animal movements in three dimensions. Five out of six exposed whales reacted strongly to alert signals at measured received levels between 130 and 150 dB (i.e., ceased foraging and swam rapidly to the surface). Two of these individuals were not exposed to ship noise, and the other four were exposed to both stimuli. These whales reacted mildly to conspecific signals. Seven whales, including the four

exposed to the alert stimulus, had no measurable response to either ship sounds or actual vessel noise.

Baleen whale responses to pulsed sound (e.g., seismic airguns) have been studied more thoroughly than responses to continuous sound (e.g., drill rigs). Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much greater distances (Miller *et al.*, 2005). However, baleen whales exposed to strong noise pulses often react by deviating from their normal migration route (Richardson *et al.*, 1999). Migrating gray and bowhead whales were observed avoiding the sound source by displacing their migration route to varying degrees but within the natural boundaries of the migration corridors (Schick and Urban, 2000; Richardson *et al.*, 1999; Malme *et al.*, 1983). Baleen whale responses to pulsed sound however may depend on the type of activity in which the whales are engaged. Some evidence suggests that feeding bowhead whales may be more tolerant of underwater sound than migrating bowheads (Miller *et al.*, 2005; Lyons *et al.*, 2009; Christie *et al.*, 2010).

Results of studies of gray, bowhead, and humpback whales have determined that received levels of pulses in the 160–170 dB re 1 μ Pa rms range seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed. In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 2.8-9 mi (4.5-14.5 km) from the source. For the much smaller airgun array used during the VSP survey (total discharge volume between 600 and 880 in³), the distance to a received level of 160 dB re 1 μ Pa rms is estimated to be 1.53 mi (2.47 km). Baleen whales within those sound isopleths may show avoidance or other strong disturbance reactions to the airgun array.

Malme *et al.* (1986, 1988) studied the responses of feeding eastern gray whales to pulses from a single 100 in³ airgun off St. Lawrence Island in the northern Bering Sea. They estimated, based on small sample sizes, that 50% of feeding gray whales ceased feeding at an average received pressure level of 173 dB re 1 μ Pa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB. Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast and on observations of the distribution of feeding Western Pacific gray whales off Sakhalin Island, Russia, during a seismic survey (Yazvenko *et al.*, 2007).

Data on short-term reactions (or lack of reactions) of cetaceans to impulsive noises do not necessarily provide information about long-term effects. While it is not certain whether impulsive noises affect reproductive rate or distribution and habitat use in subsequent days or years, certain species have continued to use areas ensonified by airguns and have continued to increase in number despite successive years of anthropogenic activity in the area. Behavioral responses to noise exposure are generally highly variable and context dependent (Wartzok *et al.* 2004). Travelling blue and fin whales (*Balaenoptera physalus*) exposed to seismic noise from airguns have been reported to stop emitting redundant songs (McDonald *et al.* 1995; Clark & Gagnon 2006). By contrast, Iorio and Clark (2010) found increased production of transient, non-redundant calls of blue whales during seismic sparker operations. In any event, the brief exposures to sound pulses from the proposed airgun source (the airguns will only be fired for a few hours at a time over the course of 1 to 2 days) are highly unlikely to result in prolonged effects.

Toothed Whales—Most toothed whales have their greatest hearing sensitivity at frequencies much higher than that of baleen whales and may be less responsive to low-frequency

sound commonly associated with oil and gas industry exploratory drilling activities. Richardson *et al.* (1995b) reported that beluga whales did not show any apparent reaction to playback of underwater drilling sounds at distances greater than 656-1,312 ft (200-400 m). Reactions included slowing down, milling, or reversal of course after which the whales continued past the projector, sometimes within 164-328 ft (50-100 m). The authors concluded (based on a small sample size) that the playback of drilling sounds had no biologically significant effects on migration routes of beluga whales migrating through pack ice and along the seaward side of the nearshore lead east of Point Barrow in spring.

At least six of 17 groups of beluga whales appeared to alter their migration path in response to underwater playbacks of icebreaker sound (Richardson *et al.*, 1995b). Received levels from the icebreaker playback were estimated at 78-84 dB in the 1/3-octave band centered at 5,000 Hz, or 8-14 dB above ambient. If beluga whales reacted to an actual icebreaker at received levels of 80 dB, reactions would be expected to occur at distances on the order of 6.2 mi (10 km). Finley *et al.* (1990) also reported beluga avoidance of icebreaker activities in the Canadian High Arctic at distances of 22-31 mi (35-50 km). In addition to avoidance, changes in dive behavior and pod integrity were also noted. However, no icebreakers will be used during this proposed program.

Patenaude *et al.* (2002) reported changes in beluga whale diving and respiration behavior, and some whales veered away when a helicopter passed at ≤ 820 ft (250 m) lateral distance at altitudes up to 492 ft (150 m). However, some belugas showed no reaction to the helicopter. Belugas appeared to show less response to fixed-wing aircraft than to helicopter overflights.

In reviewing responses of cetaceans with best hearing in mid-frequency ranges, which includes toothed whales, Southall *et al.* (2007) reported that combined field and laboratory data

for mid-frequency cetaceans exposed to non-pulse sounds did not lead to a clear conclusion about received levels coincident with various behavioral responses. In some settings, individuals in the field showed profound (significant) behavioral responses to exposures from 90-120 dB, while others failed to exhibit such responses for exposure to received levels from 120-150 dB. Contextual variables other than exposure received level, and probable species differences, are the likely reasons for this variability. Context, including the fact that captive subjects were often directly reinforced with food for tolerating noise exposure, may also explain why there was great disparity in results from field and laboratory conditions—exposures in captive settings generally exceeded 170 dB before inducing behavioral responses. A summary of some of the relevant material reviewed by Southall *et al.* (2007) is next.

Buckstaff (2004) reported elevated bottlenose dolphin (*Tursiops truncatus*) whistle rates with received levels from oncoming vessels in the 110 to 120 dB range in Sarasota Bay, Florida. These hearing thresholds were apparently lower than those reported by a researcher listening with towed hydrophones. Morisaka *et al.* (2005) compared whistles from three populations of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*). One population was exposed to vessel noise with spectrum levels of approximately 85 dB/Hz in the 1- to 22-kHz band (broadband received levels approximately 128 dB) as opposed to approximately 65 dB/Hz in the same band (broadband received levels approximately 108 dB) for the other two sites. Dolphin whistles in the noisier environment had lower fundamental frequencies and less frequency modulation, suggesting a shift in sound parameters as a result of increased ambient noise.

Morton and Symonds (2002) used census data on killer whales in British Columbia to evaluate avoidance of non-pulse acoustic harassment devices (AHDs). Avoidance ranges were about 2.5 mi (4 km). Also, there was a dramatic reduction in the number of days “resident”

killer whales were sighted during AHD-active periods compared to pre- and post-exposure periods and a nearby control site.

Monteiro-Neto *et al.* (2004) studied avoidance responses of tucuxi (*Sotalia fluviatilis*), a freshwater dolphin, to Dukane® Netmark acoustic deterrent devices. In a total of 30 exposure trials, approximately five groups each demonstrated significant avoidance compared to 20 “pinger off” and 55 “no-pinger” control trials over two quadrants of about 0.19 mi² (0.5 km²). Estimated exposure received levels were approximately 115 dB.

Awbrey and Stewart (1983) played back semi-submersible drillship sounds (source level: 163 dB) to belugas in Alaska. They reported avoidance reactions at 984 and 4,921 ft (300 and 1,500 m) and approach by groups at a distance of 2.2 mi (3.5 km; received levels were approximately 110 to 145 dB over these ranges assuming a 15 log R transmission loss). Similarly, Richardson *et al.* (1990) played back drilling platform sounds (source level: 163 dB) to belugas in Alaska. They conducted aerial observations of eight individuals among approximately 100 spread over an area several hundred meters to several kilometers from the sound source and found no obvious reactions. Moderate changes in movement were noted for three groups swimming within 656 ft (200 m) of the sound projector.

Two studies deal with issues related to changes in marine mammal vocal behavior as a function of variable background noise levels. Foote *et al.* (2004) found increases in the duration of killer whale calls over the period 1977 to 2003, during which time vessel traffic in Puget Sound, and particularly whale-watching boats around the animals, increased dramatically. Scheifele *et al.* (2005) demonstrated that belugas in the St. Lawrence River increased the levels of their vocalizations as a function of the background noise level (the “Lombard Effect”).

Several researchers conducting laboratory experiments on hearing and the effects of non-

pulse sounds on hearing in mid-frequency cetaceans have reported concurrent behavioral responses. Nachtigall *et al.* (2003) reported that noise exposures up to 179 dB and 55-min duration affected the trained behaviors of a bottlenose dolphin participating in a temporary threshold shift (TTS) experiment. Finneran and Schlundt (2004) provided a detailed, comprehensive analysis of the behavioral responses of belugas and bottlenose dolphins to 1-s tones (received levels 160 to 202 dB) in the context of TTS experiments. Romano *et al.* (2004) investigated the physiological responses of a bottlenose dolphin and a beluga exposed to these tonal exposures and demonstrated a decrease in blood cortisol levels during a series of exposures between 130 and 201 dB. Collectively, the laboratory observations suggested the onset of a behavioral response at higher received levels than did field studies. The differences were likely related to the very different conditions and contextual variables between untrained, free-ranging individuals vs. laboratory subjects that were rewarded with food for tolerating noise exposure.

Seismic operators and marine mammal observers sometimes see dolphins and other small toothed whales near operating airgun arrays, but, in general, there seems to be a tendency for most delphinids to show some limited avoidance of seismic vessels operating large airgun systems. However, some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing. Nonetheless, there have been indications that small toothed whales sometimes move away or maintain a somewhat greater distance from the vessel when a large array of airguns is operating than when it is silent (e.g., Goold, 1996a,b,c; Calambokidis and Osmeck, 1998; Stone, 2003). The beluga may be a species that (at least at times) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea recorded much lower sighting rates of beluga whales within 6.2-12.4 mi (10–20 km) of an active seismic vessel.

These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might be avoiding the seismic operations at distances of 6.2-12.4 mi (10–20 km) (Miller *et al.*, 2005).

Observers stationed on seismic vessels operating off the United Kingdom from 1997 - 2000 have provided data on the occurrence and behavior of various toothed whales exposed to seismic pulses (Stone, 2003; Gordon *et al.*, 2004). Killer whales were found to be significantly farther from large airgun arrays during periods of shooting compared with periods of no shooting. The displacement of the median distance from the array was approximately 0.5 km (0.3 mi) or more. Killer whales also appear to be more tolerant of seismic shooting in deeper water.

Captive bottlenose dolphins and beluga whales exhibit changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran *et al.*, 2002, 2005). However, the animals tolerated high received levels of sound (p-p level >200 dB re 1 μ Pa) before exhibiting aversive behaviors.

Pinnipeds—Pinnipeds generally seem to be less responsive to exposure to industrial sound than most cetaceans. Pinniped responses to underwater sound from some types of industrial activities such as seismic exploration appear to be temporary and localized (Harris *et al.*, 2001; Reiser *et al.*, 2009).

Southall *et al.* (2007) reviewed literature describing responses of pinnipeds to non-pulsed sound and reported that the limited data suggest exposures between approximately 90 and 140 dB generally do not appear to induce strong behavioral responses in pinnipeds exposed to non-pulse sounds in water; no data exist regarding exposures at higher levels. It is important to note that among these studies, there are some apparent differences in responses between field and laboratory conditions. In contrast to the mid-frequency odontocetes, captive pinnipeds responded

more strongly at lower levels than did animals in the field. Again, contextual issues are the likely cause of this difference.

Jacobs and Terhune (2002) observed harbor seal reactions to Acoustic Harassment Devices (AHD) (source level in this study was 172 dB) deployed around aquaculture sites. Seals were generally unresponsive to sounds from the AHDs. During two specific events, individuals came within 141 and 144 ft (43 and 44 m) of active AHDs and failed to demonstrate any measurable behavioral response; estimated received levels based on the measures given were approximately 120 to 130 dB.

Costa *et al.* (2003) measured received noise levels from an Acoustic Thermometry of Ocean Climate (ATOC) program sound source off northern California using acoustic data loggers placed on translocated elephant seals. Subjects were captured on land, transported to sea, instrumented with archival acoustic tags, and released such that their transit would lead them near an active ATOC source (at 939-m depth; 75-Hz signal with 37.5- Hz bandwidth; 195 dB maximum source level, ramped up from 165 dB over 20 min) on their return to a haul-out site. Received exposure levels of the ATOC source for experimental subjects averaged 128 dB (range 118 to 137) in the 60- to 90-Hz band. None of the instrumented animals terminated dives or radically altered behavior upon exposure, but some statistically significant changes in diving parameters were documented in nine individuals. Translocated northern elephant seals exposed to this particular non-pulse source began to demonstrate subtle behavioral changes at exposure to received levels of approximately 120 to 140 dB.

Kastelein *et al.* (2006) exposed nine captive harbor seals in an approximately 82 × 98 ft (25 × 30 m) enclosure to non-pulse sounds used in underwater data communication systems (similar to acoustic modems). Test signals were frequency modulated tones, sweeps, and bands

of noise with fundamental frequencies between 8 and 16 kHz; 128 to 130 [± 3] dB source levels; 1- to 2-s duration [60-80 percent duty cycle]; or 100 percent duty cycle. They recorded seal positions and the mean number of individual surfacing behaviors during control periods (no exposure), before exposure, and in 15-min experimental sessions ($n = 7$ exposures for each sound type). Seals generally swam away from each source at received levels of approximately 107 dB, avoiding it by approximately 16 ft (5 m), although they did not haul out of the water or change surfacing behavior. Seal reactions did not appear to wane over repeated exposure (i.e., there was no obvious habituation), and the colony of seals generally returned to baseline conditions following exposure. The seals were not reinforced with food for remaining in the sound field.

Potential effects to pinnipeds from aircraft activity could involve both acoustic and non-acoustic effects. It is uncertain if the seals react to the sound of the helicopter or to its physical presence flying overhead. Typical reactions of hauled out pinnipeds to aircraft that have been observed include looking up at the aircraft, moving on the ice or land, entering a breathing hole or crack in the ice, or entering the water. Ice seals hauled out on the ice have been observed diving into the water when approached by a low-flying aircraft or helicopter (Burns and Harbo, 1972, cited in Richardson *et al.*, 1995a; Burns and Frost, 1979, cited in Richardson *et al.*, 1995a). Richardson *et al.* (1995a) note that responses can vary based on differences in aircraft type, altitude, and flight pattern.

Blackwell *et al.* (2004a) observed 12 ringed seals during low-altitude overflights of a Bell 212 helicopter at Northstar in June and July 2000 (nine observations took place concurrent with pipe-driving activities). One seal showed no reaction to the aircraft while the remaining 11 (92%) reacted, either by looking at the helicopter ($n=10$) or by departing from their basking site ($n=1$). Blackwell *et al.* (2004a) concluded that none of the reactions to helicopters were strong or

long lasting, and that seals near Northstar in June and July 2000 probably had habituated to industrial sounds and visible activities that had occurred often during the preceding winter and spring. There have been few systematic studies of pinniped reactions to aircraft overflights, and most of the available data concern pinnipeds hauled out on land or ice rather than pinnipeds in the water (Richardson *et al.*, 1995a; Born *et al.*, 1999).

Reactions of harbor seals to the simulated sound of a 2-megawatt wind power generator were measured by Koschinski *et al.* (2003). Harbor seals surfaced significantly further away from the sound source when it was active and did not approach the sound source as closely. The device used in that study produced sounds in the frequency range of 30 to 800 Hz, with peak source levels of 128 dB at 1 m at the 80- and 160-Hz frequencies.

Pinnipeds are not likely to show a strong avoidance reaction to the airgun sources proposed for use. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds and only slight (if any) changes in behavior. Monitoring work in the Alaskan Beaufort Sea during 1996–2001 provided considerable information regarding the behavior of Arctic ice seals exposed to seismic pulses (Harris *et al.*, 2001; Moulton and Lawson, 2002). These seismic projects usually involved arrays of 6 to 16 airguns with total volumes of 560 to 1,500 in³. The combined results suggest that some seals avoid the immediate area around seismic vessels. In most survey years, ringed seal sightings tended to be farther away from the seismic vessel when the airguns were operating than when they were not (Moulton and Lawson, 2002). However, these avoidance movements were relatively small, on the order of 100 m (328 ft) to a few hundreds of meters, and many seals remained within 100–200 m (328–656 ft) of the trackline as the operating airgun array passed by. Seal sighting rates at the water surface were lower during airgun array operations than during no-airgun periods in each survey year except

1997. Similarly, seals are often very tolerant of pulsed sounds from seal-scaring devices (Mate and Harvey, 1987; Jefferson and Curry, 1994; Richardson *et al.*, 1995a). However, initial telemetry work suggests that avoidance and other behavioral reactions by two other species of seals to small airgun sources may at times be stronger than evident to date from visual studies of pinniped reactions to airguns (Thompson *et al.*, 1998). Even if reactions of the species occurring in the present study area are as strong as those evident in the telemetry study, reactions are expected to be confined to relatively small distances and durations.

4. Threshold Shift (Noise-induced Loss of Hearing)

When animals exhibit reduced hearing sensitivity (i.e., sounds must be louder for an animal to detect them) following exposure to an intense sound or sound for long duration, it is referred to as a noise-induced threshold shift (TS). An animal can experience temporary threshold shift (TTS) or permanent threshold shift (PTS). TTS can last from minutes or hours to days (i.e., there is complete recovery), can occur in specific frequency ranges (i.e., an animal might only have a temporary loss of hearing sensitivity between the frequencies of 1 and 10 kHz), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced initially by only 6 dB or reduced by 30 dB). PTS is permanent, but some recovery is possible. PTS can also occur in a specific frequency range and amount as mentioned above for TTS.

The following physiological mechanisms are thought to play a role in inducing auditory TS: effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.*, 2007). The amplitude,

duration, frequency, temporal pattern, and energy distribution of sound exposure all can affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, so, generally, does the amount of TS, along with the recovery time. For intermittent sounds, less TS could occur than compared to a continuous exposure with the same energy (some recovery could occur between intermittent exposures depending on the duty cycle between sounds) (Kryter *et al.*, 1966; Ward, 1997). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward, 1997). Additionally, though TTS is temporary, prolonged exposure to sounds strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter, 1985). However, in the case of the proposed drilling program, animals are not expected to be exposed to levels high enough or durations long enough to result in PTS, as described in detail in the paragraphs below.

PTS is considered auditory injury (Southall *et al.*, 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.*, 2007).

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. For marine mammals, published data are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (Finneran *et*

al., 2000, 2002b, 2003, 2005a, 2007, 2010a, 2010b; Finneran and Schlundt, 2010; Lucke *et al.*, 2009; Mooney *et al.*, 2009a, 2009b; Popov *et al.*, 2011a, 2011b; Kastelein *et al.*, 2012a; Schlundt *et al.*, 2000; Nachtigall *et al.*, 2003, 2004). For pinnipeds in water, data are limited to measurements of TTS in harbor seals, an elephant seal, and California sea lions (Kastak *et al.*, 1999, 2005; Kastelein *et al.*, 2012b).

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (i.e., recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious (similar to those discussed in auditory masking, below). For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts. Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it is considered generally more serious because it is a permanent condition. Of note, reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.*, 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without cost.

Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS would occur during the proposed drilling program in Cook Inlet due to the relatively short duration of activities producing these higher level sounds in

combination with mitigation and monitoring efforts to avoid such effects.

5. Non-auditory Physical Effects

Non-auditory physical effects might occur in marine mammals exposed to strong underwater sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. Some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds.

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg, 2000; Sapolsky *et al.*, 2005; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: behavioral responses; autonomic nervous system responses; neuroendocrine responses; or immune responses.

In the case of many stressors, an animal's first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical "fight or flight" response, which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with "stress." These responses have a relatively short duration and may or may not have significant long-term effects on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine or sympathetic nervous systems; the system that has received the most study has been the hypothalamus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuroendocrine functions that are affected by stress – including immune competence, reproduction, metabolism, and behavior – are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987; Rivier, 1995), altered metabolism (Elasser *et al.*, 2000), reduced immune competence (Blecha, 2000), and behavioral disturbance. Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al.*, 2004) have been equated with stress for many years.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic functions, which impair those functions that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting a stress response diverts energy from a fetus, an animal's reproductive success and fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called "distress" (*sensu* Seyle, 1950) or "allostatic loading" (*sensu* McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its

biotic reserves sufficient to restore normal function. Note that these examples involved a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiment; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.*, 1996; Hood *et al.*, 1998; Jessop *et al.*, 2003; Krausman *et al.*, 2004; Lankford *et al.*, 2005; Reneerkens *et al.*, 2002; Thompson and Hamer, 2000). Although no information has been collected on the physiological responses of marine mammals to anthropogenic sound exposure, studies of other marine animals and terrestrial animals would lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological responses that would be classified as “distress” upon exposure to anthropogenic sounds. For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (e.g., elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al.* (2004a, 2004b) identified noise-induced physiological transient stress responses in hearing-specialist fish (i.e., goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and communicate with conspecifics. Although empirical information on the effects of sensory impairment (TTS, PTS, and acoustic masking) on marine mammals remains limited, we assume that reducing a marine mammal's ability to gather information about its environment and communicate with other members of its species would induce stress, based on data that terrestrial animals exhibit those responses under similar conditions (NRC, 2003) and because marine mammals use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses. Marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), NMFS also assumes that stress responses could persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS. The source level of the jack-up rig is not loud enough to induce PTS or likely even TTS.

Resonance effects (Gentry, 2002) and direct noise-induced bubble formations (Crum *et al.*, 2005) are implausible in the case of exposure to an impulsive broadband source like an airgun array. If seismic surveys disrupt diving patterns of deep-diving species, this might result in bubble formation and a form of the bends, as speculated to occur in beaked whales exposed to sonar. However, there is no specific evidence of this upon exposure to airgun pulses.

In general, very little is known about the potential for strong, anthropogenic underwater sounds to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged

period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.*, 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns, which are not proposed for use during this program. For the most part, only low-level continuous sounds would be produced during the drilling program as impact hammering and VSP would occur for only short periods of time and most of the sound produced would be from the ongoing operation/drilling. In addition, marine mammals that show behavioral avoidance of industry activities, including belugas and some pinnipeds, are especially unlikely to incur non-auditory impairment or other physical effects.

6. Stranding and Mortality

Marine mammals close to underwater detonations of high explosive can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten *et al.*, 1993; Ketten, 1995). Airgun pulses are less energetic and their peak amplitudes have slower rise times. To date, there is no evidence that serious injury, death, or stranding by marine mammals can occur from exposure to airgun pulses, even in the case of large airgun arrays. Additionally, the airguns used during VSP are used for short periods of time. The continuous sounds produced by the drill rig are also far less energetic.

It should be noted that strandings known, or thought, to be related to sound exposure have not been recorded for marine mammal species in Cook Inlet. Beluga whale strandings in Cook Inlet are not uncommon; however, these events often coincide with extreme tidal fluctuations (“spring tides”) or killer whale sightings (Shelden *et al.*, 2003). For example, in August 2012, a group of Cook Inlet beluga whales stranded in the mud flats of Turnagain Arm

during low tide and were able to swim free with the flood tide. NMFS does not expect any marine mammals will incur serious injury or mortality in Cook Inlet or strand as a result of the proposed drilling program.

Vessel Impacts

Vessel activity and noise associated with vessel activity will temporarily increase in the action area during BlueCrest's oil and gas production drilling program as a result of the operation of a jack-up drill rig and the use of tow and other support vessels. While under tow, the rig and the tow vessels move at slow speeds (2-4 knots). The support barges supplying pipe to the drill rig can typically run at 7-8 knots but may move slower inside Cook Inlet. Based on this information, NMFS does not anticipate and does not propose to authorize take from vessel strikes.

Odontocetes, such as beluga whales, killer whales, and harbor porpoises, often show tolerance to vessel activity; however, they may react at long distances if they are confined by ice, shallow water, or were previously harassed by vessels (Richardson *et al.*, 1995a). Beluga whale response to vessel noise varies greatly from tolerance to extreme sensitivity depending on the activity of the whale and previous experience with vessels (Richardson *et al.*, 1995a). Reactions to vessels depends on whale activities and experience, habitat, boat type, and boat behavior (Richardson *et al.*, 1995a) and may include behavioral responses, such as altered headings or avoidance (Blane and Jaakson, 1994; Erbe and Farmer, 2000); fast swimming; changes in vocalizations (Lesage *et al.*, 1999; Scheifele *et al.*, 2005); and changes in dive, surfacing, and respiration patterns.

There are few data published on pinniped responses to vessel activity, and most of the information is anecdotal (Richardson *et al.*, 1995a). Generally, sea lions in water show tolerance

to close and frequently approaching vessels and sometimes show interest in fishing vessels. They are less tolerant when hauled out on land; however, they rarely react unless the vessel approaches within 100-200 m (330-660 ft; reviewed in Richardson *et al.*, 1995a).

Oil Spill and Discharge Impacts

As noted above, the specified activity involves towing the rig, drilling of wells, and other associated support activities in lower Cook Inlet during the 2016 open water season. The primary stressors to marine mammals that are reasonably expected to occur will be acoustic in nature. The likelihood of a large oil spill occurring during BlueCrest's proposed drilling program is remote and effects from an event of this nature are not authorized. Offshore oil spill records in Cook Inlet during 1994-2011 show three spills during oil exploration (ADNR Division of Oil and Gas, 2011 unpub. data): two oil spills at the UNOCAL Dillion Platform in June 2011 (two gallons) and December 2001 (three gallons); and one oil spill at the UNOCAL Monopod Platform in January 2002 (one gallon). During this same time period, 71 spills occurred offshore in Cook Inlet during oil production. Most spills ranged from 0.0011 to 1 gallon (42 spills), and only three spills were larger than 200 gallons: 210 gallons in July 2001 at the Cook Inlet Energy Stewart facility; 250 gallons in February 1998 at the King Salmon platform; and 504 gallons in October 1999 at the UNOCAL Dillion platform. All 71 crude oil spills from the offshore platforms, both exploration and production, totaled less than 2,140 gallons. Based on historical data, most oil spills have been small. Moreover, during more than 60 years of oil and gas exploration and development in Cook Inlet, there has not been a single oil well blowout, making it difficult to assign a specific risk factor to the possibility of such an event in Cook Inlet. However, the probability of such an event is thought to be extremely low.

BlueCrest will have various measures and protocols in place that will be implemented to

prevent oil releases from the wellbore. BlueCrest has planned formal routine rig maintenance and surveillance checks, as well as normal inspection and equipment checks to be conducted on the jack-up rig daily. The following steps will be in place to prevent oil from entering the water:

- Required inspections will follow standard operating procedures.
- Personnel working on the rig will be directed to report any unusual conditions to appropriate personnel.
- Oily equipment will be regularly wiped down with oil absorbent pads to collect free oil. Drips and small spillage from equipment will be controlled through use of drip pans and oil absorbent drop clothes.
- Oil absorbent materials used to contain oil spills or seeps will be collected and disposed of in sealed plastic bags or metal drums and closed containers.
- The platform surfaces will be kept clean of waste materials and loose debris on a daily basis.
- Remedial actions will be taken when visual inspections indicate deterioration of equipment (tanks) and/or their control systems.
- Following remedial work, and as appropriate, tests will be conducted to determine that the systems function correctly.

Drilling and completion fluids provide primary well control during drilling, work over, or completion operations. These fluids are designed to exert hydrostatic pressure on the wellbore that exceeds the pore pressures within the subsurface formations. This prevents undesired fluid flow into the wellbore. Surface mounted blowout preventer (BOP) equipment provides secondary well control. In the event that primary well control is lost, this surface equipment is used to contain the influx of formation fluid and then safely circulate it out of the wellbore.

The BOP is a large, specialized valve used to seal, control, and monitor oil and gas wells. BOPs come in variety of styles, sizes, and pressure ratings. For Cook Inlet, the BOP equipment used by BlueCrest will consist of:

- Three BOPs pressure safety levels of: 1) 5,000 pounds per square inch (psi), 2) 10,000 psi, and 3) 15,000 psi;
- A minimum of three 35 cm (13 5/8 in), 10,000 psi WP ram type preventers;
- One 35 cm (13 5/8 in) annular preventer;
- Choke and kill lines that provide circulating paths from/to the choke manifold;
- A two choke manifold that allows for safe circulation of well influxes out of the well bore; and
- A hydraulic control system with accumulator backup closing.

The wellhead, associated valves, and control systems provide blowout prevention during well production. These systems provide several layers of redundancy to ensure pressure containment is maintained. Well control planning is performed in accordance with Alaska Oil and Gas Conservation Commission (AOGCC) and the Department of the Interior's Bureau of Safety and Environment Enforcement (BSEE) regulations. The operator's policies and recommended practices are, at a minimum, equivalent to BSEE regulations. BOP test drills are performed on a frequent basis to ensure the well will be shut in quickly and properly. BOP testing procedures will meet American Petroleum Institute Recommended Practice No. 53 and AOGCC specifications. The BOP tests will be conducted with a nonfreezing fluid when the ambient temperature around the BOP stack is below 0° C (32° F). Tests will be conducted at least weekly and before drilling out the shoe of each casing string. The AOGCC will be contacted before each test is conducted, and will be onsite during BOP tests unless an inspection

waiver is approved.

BlueCrest developed an Oil Discharge Prevention and Contingency Plan (ODPCP) and has submitted it for approval to Alaska's Department of Environmental Conservation (ADEC). NMFS reviewed the previous ODPCP covering the Cosmopolitan drilling program (prepared by Buccaneer Alaska Operations LLC) during the ESA consultation process for Cosmopolitan leases and found that with implementation of the safety features mentioned above that the risk of an oil spill was discountable. As an oil spill is not a likely occurrence, it is not a component of BlueCrest's specified activity for which NMFS is proposing to authorize take.

Anticipated Effects on Marine Mammal Habitat

The primary potential impacts to marine mammals and other marine species are associated with elevated sound levels produced by the drilling program (i.e. towing of the drill rig and the airguns). However, other potential impacts are also possible to the surrounding habitat from physical disturbance, discharges, and an oil spill (which we do not anticipate or authorize). This section describes the potential impacts to marine mammal habitat from the specified activity, including impacts on fish and invertebrate species typically preyed upon by marine mammals in the area.

Common Marine Mammal Prey in the Proposed Drilling Area

Fish are the primary prey species for marine mammals in Cook Inlet. Beluga whales feed on a variety of fish, shrimp, squid, and octopus (Burns and Seaman, 1986). Common prey species in Knik Arm include salmon, eulachon and cod. Harbor seals feed on fish such as pollock, cod, capelin, eulachon, Pacific herring, and salmon, as well as a variety of benthic species, including crabs, shrimp, and cephalopods. Harbor seals are also opportunistic feeders with their diet varying with season and location. The preferred diet of the harbor seal in the Gulf

of Alaska consists of pollock, octopus, capelin, eulachon, and Pacific herring (Calkins, 1989). Other prey species include cod, flat fishes, shrimp, salmon, and squid (Hoover, 1988). Harbor porpoises feed primarily on Pacific herring, cod, whiting (hake), pollock, squid, and octopus (Leatherwood *et al.*, 1982). In the Cook Inlet area, harbor porpoise feed on squid and a variety of small schooling fish, which would likely include Pacific herring and eulachon (Bowen and Siniff, 1999; NMFS, unpublished data). Killer whales feed on either fish or other marine mammals depending on genetic type (resident versus transient respectively). Killer whales in Knik Arm are typically the transient type (Shelden *et al.*, 2003) and feed on beluga whales and other marine mammals, such as harbor seal and harbor porpoise. The Steller sea lion diet consists of a variety of fishes (capelin, cod, herring, mackerel, pollock, rockfish, salmon, sand lance, etc.), bivalves, squid, octopus, and gastropods.

Potential Impacts from Seafloor Disturbance on Marine Mammal Habitat

There is a possibility of seafloor disturbance or increased turbidity in the vicinity of the drill sites. Seafloor disturbance could occur with bottom founding of the drill rig legs and anchoring system. These activities could lead to direct effects on bottom fauna, through either displacement or mortality. Increase in suspended sediments from seafloor disturbance also has the potential to indirectly affect bottom fauna and fish. The amount and duration of disturbed or turbid conditions will depend on sediment material.

The potential direct habitat impact by the BlueCrest drilling operation is limited to the actual drill-rig footprint defined as the area occupied and enclosed by the drill-rig legs. The jack-up rig will temporarily disturb one offshore location in lower Cook Inlet, where the wells are proposed to be drilled. Bottom disturbance would occur in the area where the three legs of the rig would be set down and where the actual wells would be drilled. The jack-up drill rig footprint

would occupy three steel piles at 14 m (46 ft) diameter. The well casing would be a 76 cm (30 in) diameter pipe extending from the seafloor to the rig floor. The casing would only be in place during drilling activities at each potential well location. The total area of disturbance was calculated as 0.54 acres during the land use permitting process. The collective 2-acre footprint of the wells represents a very small fraction of the 7,300 square mile Cook Inlet surface area. Potential damage to the Cook Inlet benthic community will be limited to the actual surface area of the three spudcans (1,585 square feet each or 4,755 square feet total) that form the “foot” of each leg. Given the high tidal energy at the well site locations, drilling footprints are not expected to support benthic communities equivalent to shallow lower energy sites found in nearshore waters where harbor seals mostly feed. The presence of the drill rig is not expected to result in direct loss of marine mammal habitat.

Potential Impacts from Sound Generation

With regard to fish as a prey source for odontocetes and seals, fish are known to hear and react to sounds and to use sound to communicate (Tavolga *et al.*, 1981) and possibly avoid predators (Wilson and Dill, 2002). Experiments have shown that fish can sense both the strength and direction of sound (Hawkins, 1981). Primary factors determining whether a fish can sense a sound signal, and potentially react to it, are the frequency of the signal and the strength of the signal in relation to the natural background noise level.

Fish produce sounds that are associated with behaviors that include territoriality, mate search, courtship, and aggression. It has also been speculated that sound production may provide the means for long distance communication and communication under poor underwater visibility conditions (Zelick *et al.*, 1999), although the fact that fish communicate at low-frequency sound levels where the masking effects of ambient noise are naturally highest suggests that very long

distance communication would rarely be possible. Fish have evolved a diversity of sound generating organs and acoustic signals of various temporal and spectral contents. Fish sounds vary in structure, depending on the mechanism used to produce them (Hawkins, 1993). Generally, fish sounds are predominantly composed of low frequencies (less than 3 kHz).

Since objects in the water scatter sound, fish are able to detect these objects through monitoring the ambient noise. Therefore, fish are probably able to detect prey, predators, conspecifics, and physical features by listening to environmental sounds (Hawkins, 1981). There are two sensory systems that enable fish to monitor the vibration-based information of their surroundings. The two sensory systems, the inner ear and the lateral line, constitute the acoustico-lateralis system.

Although the hearing sensitivities of very few fish species have been studied to date, it is becoming obvious that the intra- and inter-specific variability is considerable (Coombs, 1981). Nedwell *et al.* (2004) compiled and published available fish audiogram information. A noninvasive electrophysiological recording method known as auditory brainstem response is now commonly used in the production of fish audiograms (Yan, 2004). Generally, most fish have their best hearing in the low-frequency range (i.e., less than 1 kHz). Even though some fish are able to detect sounds in the ultrasonic frequency range, the thresholds at these higher frequencies tend to be considerably higher than those at the lower end of the auditory frequency range.

Literature relating to the impacts of sound on marine fish species can be divided into the following categories: (1) pathological effects; (2) physiological effects; and (3) behavioral effects. Pathological effects include lethal and sub-lethal physical damage to fish; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors of fish. Behavioral changes might be a direct reaction to a detected sound or

a result of the anthropogenic sound masking natural sounds that the fish normally detect and to which they respond. The three types of effects are often interrelated in complex ways. For example, some physiological and behavioral effects could potentially lead to the ultimate pathological effect of mortality. Hastings and Popper (2005) reviewed what is known about the effects of sound on fishes and identified studies needed to address areas of uncertainty relative to measurement of sound and the responses of fishes. Popper *et al.* (2003/2004) also published a paper that reviews the effects of anthropogenic sound on the behavior and physiology of fishes.

Potential effects of exposure to continuous sound on marine fish include TTS, physical damage to the ear region, physiological stress responses, and behavioral responses such as startle response, alarm response, avoidance, and perhaps lack of response due to masking of acoustic cues. Most of these effects appear to be either temporary or intermittent and therefore probably do not significantly impact the fish at a population level. The studies that resulted in physical damage to the fish ears used noise exposure levels and durations that were far more extreme than would be encountered under conditions similar to those expected during BlueCrest's proposed exploratory drilling activities.

The level of sound at which a fish will react or alter its behavior is usually well above the detection level. Fish have been found to react to sounds when the sound level increased to about 20 dB above the detection level of 120 dB (Ona, 1988); however, the response threshold can depend on the time of year and the fish's physiological condition (Engas *et al.*, 1993). In general, fish react more strongly to pulses of sound rather than a continuous signal (Blaxter *et al.*, 1981), such as the type of sound that will be produced by the drillship, and a quicker alarm response is elicited when the sound signal intensity rises rapidly compared to sound rising more slowly to the same level.

Investigations of fish behavior in relation to vessel noise (Olsen *et al.*, 1983; Ona, 1988; Ona and Godo, 1990) have shown that fish react when the sound from the engines and propeller exceeds a certain level. Avoidance reactions have been observed in fish such as cod and herring when vessels approached close enough that received sound levels are 110 dB to 130 dB (Nakken, 1992; Olsen, 1979; Ona and Godo, 1990; Ona and Toresen, 1988). However, other researchers have found that fish such as polar cod, herring, and capeline are often attracted to vessels (apparently by the noise) and swim toward the vessel (Rostad *et al.*, 2006). Typical sound source levels of vessel noise in the audible range for fish are 150 dB to 170 dB (Richardson *et al.*, 1995a). (Based on models, the 160 dB radius for the jack-up rig would extend approximately 33 ft [10 m]; therefore, fish would need to be in close proximity to the drill rig for the noise to be audible). In calm weather, ambient noise levels in audible parts of the spectrum lie between 60 dB to 100 dB.

BlueCrest also proposes to conduct VSP surveys with an airgun array for a short period of time during the drilling season (only a few hours over 1-2 days over the course of the entire proposed drilling program). Airguns produce impulsive sounds as opposed to continuous sounds at the source. Short, sharp sounds can cause overt or subtle changes in fish behavior. Chapman and Hawkins (1969) tested the reactions of whiting (hake) in the field to an airgun. When the airgun was fired, the fish dove from 82 to 180 ft (25 to 55 m) depth and formed a compact layer. The whiting dove when received sound levels were higher than 178 dB re 1 μ Pa (Pearson *et al.*, 1992).

Pearson *et al.* (1992) conducted a controlled experiment to determine effects of strong noise pulses on several species of rockfish off the California coast. They used an airgun with a source level of 223 dB re 1 μ Pa. They noted:

- Startle responses at received levels of 200–205 dB re 1 μ Pa and above for two sensitive species, but not for two other species exposed to levels up to 207 dB;
- Alarm responses at 177–180 dB for the two sensitive species, and at 186 to 199 dB for other species;
- An overall threshold for the above behavioral response at about 180 dB;
- An extrapolated threshold of about 161 dB for subtle changes in the behavior of rockfish; and
- A return to pre-exposure behaviors within the 20-60 minute exposure period.

In summary, fish often react to sounds, especially strong and/or intermittent sounds of low frequency. Sound pulses at received levels of 160 dB re 1 μ Pa may cause subtle changes in behavior. Pulses at levels of 180 dB may cause noticeable changes in behavior (Chapman and Hawkins, 1969; Pearson *et al.*, 1992; Skalski *et al.*, 1992). It also appears that fish often habituate to repeated strong sounds rather rapidly, on time scales of minutes to an hour. However, the habituation does not endure, and resumption of the strong sound source may again elicit disturbance responses from the same fish. Underwater sound levels from the drill rig and other vessels produce sounds lower than the response threshold reported by Pearson *et al.* (1992), and are not likely to result in major effects to fish near the proposed drill site.

Based on a sound level of approximately 140 dB, there may be some avoidance by fish of the area near the jack-up while drilling, around the rig under tow, and around other support and supply vessels when underway. Any reactions by fish to these sounds will last only minutes (Mitson and Knudsen, 2003; Ona *et al.*, 2007) longer than the vessel is operating at that location or the drill rig is drilling. Any potential reactions by fish would be limited to a relatively small area within about 33 ft (10 m) of the drill rig during drilling. Avoidance by some fish or fish

species could occur within portions of this area.

The lease areas do not support major populations of cod, Pollock, and sole, although all four salmon species and smelt may migrate through the area to spawning rivers in upper Cook Inlet (Shields and Dupuis, 2012). Residency time for the migrating finfish in the vicinity of an operating platform would be short-term, limiting fish exposure to noise associated with the proposed drilling program.

Some of the fish species found in Cook Inlet are prey sources for odontocetes and pinnipeds. A reaction by fish to sounds produced by BlueCrest's proposed operations would only be relevant to marine mammals if it caused concentrations of fish to vacate the area. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only very close to the sound source, if any would occur at all due to the low energy sounds produced by the majority of equipment proposed for use. Impacts on fish behavior are predicted to be inconsequential. Thus, feeding odontocetes and pinnipeds would not be adversely affected by this minimal loss or scattering, if any, which is not expected to result in reduced prey abundance. The proposed drilling area is not a common feeding area for baleen whales.

Potential Impacts from Drilling Discharges

The drill rig *Spartan151* will operate under the Alaska Pollutant Discharge Elimination System (APDES) general permit AKG-31-5021 for wastewater discharges (ADEC, 2012). This permit authorizes discharges from oil and gas extraction facilities engaged in exploration under the Offshore and Coastal Subcategories of the Oil and Gas Extraction Point Source Category (40 CFR part 435). Twelve effluents are authorized for discharge into Cook Inlet once ADEC discharge limits have been met. The authorized discharges include: drilling fluids and drill cuttings, deck drainage, sanitary waste, domestic waste, blowout preventer fluid, boiler blow

down, fire control system test water, uncontaminated ballast water, bilge water, excess cement slurry, mud cuttings cement at sea floor, and completion fluids. Areas prohibited from discharge in the Cook Inlet are 10-meter (33-foot) isobaths, 5-meter (16-foot) isobaths, and other geographic area restrictions (AKG-31-5021.I.C.). The *Spartan151* is also authorized under EPA's Vessel General Permit for deck wash down and runoff, gray water, and gray water mixed with sewage discharges. The effluent limits and related requirements for these discharges in the Vessel General Permit are to minimize or eliminate to the extent achievable using control measures (best management practices) (EPA, 2011).

Drilling wastes include drilling fluids, known as mud, rock cuttings, and formation waters. Drilling wastes (non-hydrocarbon) will be discharged to the Cook Inlet under the approved APDES general permit. Drilling wastes (hydrocarbon) will be delivered to an onshore permitted location for disposal. During drilling, the onsite tool pusher/driller and qualified mud engineers will direct and maintain desired mud properties, and maintain the quantities of basic mud materials on site as dictated by good oilfield practice. BlueCrest will follow best management practices to ensure that a sufficient inventory of barite and lost circulation materials are maintained on the drilling vessel to minimize the possibility of a well upset and the likelihood of a release of pollutants to Cook Inlet waters. These materials can be re-supplied, if required, using the supply vessel. Because adverse weather could prevent immediate re-supply, sufficient materials will be available on board to completely rebuild the total circulating volume. BlueCrest will conduct an Environmental Monitoring Study of relevant hydrographic, sediment hydrocarbon, and heavy metal data from surveys conducted before and during drilling mud disposal and up to a least one year after drilling operations cease in accordance with the APDES general permit for discharges of drilling muds and cuttings.

Non-drilling wastewater includes deck drainage, sanitary waste, domestic waste, blowout preventer fluid, boiler blow down, fire control test water, bilge water, non-contact cooling water, and uncontaminated ballast water. Non-drilling wastewater will be discharged into Cook Inlet under the approved APDES general permit or delivered to an onshore permitted location for disposal. Mud cuttings will be constantly tested. No hydrocarboned muds will be permitted to be discharged into Cook Inlet. They will be hauled offsite. Solid waste (e.g., packaging, domestic trash) will be classified, segregated, and labeled as general, universal, and Resource Conservation and Recovery Act exempt or non-exempt waste. It will be stored in containers at designated accumulation areas. Then, it will be packaged and palletized for transport to an approved on-shore disposal facility. No hazardous wastes should be generated as a result of this project. However, if any hazardous wastes were generated, it would be temporarily stored in an onboard satellite accumulation area and then transported offsite for disposal at an approved facility.

With oil and gas platforms presently operating in Cook Inlet, there is concern for continuous exposure to potentially toxic heavy metals and metalloids (i.e., mercury, lead, cadmium, copper, zinc, and arsenic) that are associated with oil and gas development and production. These elements occur naturally in the earth's crust and the oceans but many also have anthropogenic origins from local sources of pollution or from contamination from atmospheric distribution.

Discharging drill cuttings or other liquid waste streams generated by the drilling vessel could potentially affect marine mammal habitat. Toxins could persist in the water column, which could have an impact on marine mammal prey species. However, despite a considerable amount of investment in research on exposures of marine mammals to organochlorines or other toxins,

there have been no marine mammal deaths in the wild that can be conclusively linked to the direct exposure to such substances (O'Shea, 1999).

Drilling muds and cuttings discharged to the seafloor can lead to localized increased turbidity and increase in background concentrations of barium and occasionally other metals in sediments and may affect lower trophic organisms. Drilling muds are composed primarily of bentonite (clay), and the toxicity is therefore low. Heavy metals in the mud may be absorbed by benthic organisms, but studies have shown that heavy metals do not bio-magnify in marine food webs (Neff *et al.*, 1989). Effects on benthic communities are nearly always restricted to a zone within about 328 to 492 ft (100 to 150 m) of the discharge, where cuttings accumulations are greatest. Discharges and drill cuttings could impact fish by displacing them from the affected area.

Levels of heavy metals and other elements (cadmium, mercury, selenium, vanadium, and silver) were generally lower in the livers of Cook Inlet beluga whales than those of other beluga whale stocks, while copper was higher (Becker *et al.*, 2001). Hepatic methyl mercury levels were similar to those reported for other beluga whales (Geraci and St. Aubin, 1990). The relatively high hepatic concentration of silver found in the eastern Chukchi Sea and Beaufort Sea stocks of belugas was also found in the Cook Inlet animals, suggesting a species-specific phenomenon. However, because of the limited discharges, no water quality impacts are anticipated that would negatively affect habitat for Cook Inlet marine mammals.

Potential Impacts from Drill Rig Presence

The horizontal dimensions of the *Spartan151* jack-up rig are 147 ft by 30 ft. The dimensions of the drill rig (less than one football field on either side) are not significant enough to cause a large-scale diversion from the animals' normal swim and migratory paths. Any

deflection of marine mammal species due to the physical presence of the drill rig would be very minor. The drill rig's physical footprint is small relative to the size of the geographic region it will occupy and will likely not cause marine mammals to deflect greatly from their typical migratory route. Also, even if animals may deflect because of the presence of the drill rig, Cook Inlet is much larger in size than the length of the drill rig (many dozens of miles vs. less than one football field), and animals would have other means of passage around the drill rig. In sum, the physical presence of the drill rig is not likely to cause a significant deflection to migrating marine mammals.

Potential Impacts from an Oil Spill

As noted above, an oil spill is not a likely occurrence, it is not a component of BlueCrest's specified activity for which NMFS is proposing to authorize take. Also, as noted above, NMFS previously considered potential effects of an oil spill in the unlikely event that it happened and determined the effects discountable, and there has been no new information that would change this determination at this time.

Based on the consideration of potential types of impacts to marine mammal habitat, and taking into account the very low potential for a large or very large oil spill, overall, the proposed specified activity is not expected to cause significant impacts on habitats used by the marine mammal species in the proposed project area, including the food sources that they utilize.

Proposed Mitigation

In order to issue an incidental take authorization (ITA) under section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on

the availability of such species or stock for taking for certain subsistence uses (where relevant). Later in this document in the “Proposed Incidental Harassment Authorization” section, NMFS lays out the proposed conditions for review, as they would appear in the final IHA (if issued).

The drill rig does not emit sound levels that would result in Level A harassment (injury), which NMFS typically requires applicants to avoid through mitigation (such as shutdowns). For continuous sounds, such as those produced by drilling operations and rig tow, NMFS uses a received level of 120-dB (rms) for the onset of Level B harassment. For impulse sounds, such as those produced by the airgun array during the VSP surveys or the impact hammer during drive pipe driving, NMFS uses a received level of 160-dB (rms) for the onset of Level B harassment. The current Level A (injury) harassment threshold is 180 dB (rms) for cetaceans and 190 dB (rms) for pinnipeds. Table 2 outlines the various applicable radii that inform mitigation.

Table 2. Applicable Mitigation and Shutdown Radii for BlueCrest’s Proposed Lower Cook Inlet Drilling Program.

	190 dB radius	180 dB radius	160 dB radius	120 dB radius
Impact hammer during drive pipe hammering	60 m (200 ft)	250 m (820 ft)	1.6 km (1 mi)	NA
Airguns during VSP	120 m (394 ft)	240 m (787 ft)	2.5 km (1.55 mi)	NA

NA=Not applicable

Mitigation Measures Proposed by BlueCrest

For the proposed mitigation measures, BlueCrest listed the following protocols to be implemented during its drilling program in Cook Inlet.

1. Drive Pipe Hammering Measures

Two protected species observers (PSOs), working alternate shifts, will be stationed aboard the drill rig during all pipe driving activities at the well. Standard marine mammal observing field equipment will be used, including reticule binoculars (10x42), big-eye binoculars

(30x), inclinometers, and range finders. The PSOs will be stationed as close to the well head as safely possible, and will observe from the drill rig during this 2-3 day portion of the proposed program out to the 160 dB (rms) radius of 1.6 km (1 mi). Drive pipe hammering will be limited to daylight hours, and when sea conditions are light; therefore, marine mammal observation conditions will be generally good. If cetaceans enter within the 180 dB (rms) radius of 250 m (820 ft), or if pinnipeds enter within the 190 dB (rms) radius of 60 m (200 ft), then use of the impact hammer will cease. If any beluga whales, or any cetacean for which take has not been authorized, are detected entering the 160 dB disturbance zone activities will cease until the animal has been visually confirmed to clear the zone or is unseen for at least 30 minutes. Following a shutdown of impact hammering activities, the applicable zones must be clear of marine mammals for at least 30 minutes prior to restarting activities.

BlueCrest proposes to follow a ramp-up procedure during impact hammering activities. PSOs will visually monitor out to the 160 dB radius for at least 30 minutes prior to the initiation of activities. If no marine mammals are detected during that time, then BlueCrest can initiate impact hammering using a “soft start” technique. Hammering will begin with an initial set of three strikes at 40 percent energy followed by a 1 min waiting period, then two subsequent three-strike sets. This “soft-start” procedure will be implemented anytime impact hammering has ceased for 30 minutes or more. Impact hammer “soft-start” will not be required if the hammering downtime is for less than 30 minutes and visual surveys are continued throughout the silent period and no marine mammals are observed in the applicable zones during that time. Monitoring will occur during all hammering sessions.

2. VSP Airgun Measures

As with pipe driving, two PSOs will observe from the drill rig during this 1-2 day portion

of the proposed program out to the 160 dB radius of 2.5 km (1.55 mi). Standard marine mammal observing field equipment will be used, including reticule binoculars (10x42), big-eye binoculars (30x), inclinometers, and range finders. Monitoring during zero-offset VSP will be conducted by two PSOs operating from the drill rig. During walk-away VSP operations, an additional two PSOs will monitor from the seismic source vessel. VSP activities will be limited to daylight hours, and when sea conditions are light; therefore, marine mammal observation conditions will be generally good. If cetaceans enter within the 180 dB (rms) radius of 240 m (787 ft) or if pinnipeds enter within the 190 dB (rms) radius of 120 m (394 ft), then use of the airguns will cease. If any beluga whales, or any cetacean for which take has not been authorized, are detected entering the 160 dB disturbance zone, activities will cease until the animal has been visually confirmed to clear the zone or is unseen for at least 30 minutes. Following a shutdown of airgun operations, the applicable zones must be clear of marine mammals for at least 30 minutes prior to restarting activities.

BlueCrest proposes to follow a ramp-up procedure during airgun operations. PSOs will visually monitor out to the 160 dB radius for at least 30 minutes prior to the initiation of activities. If no marine mammals are detected during that time, then BlueCrest can initiate airgun operations using a “ramp-up” technique. Airgun operations will begin with the firing of a single airgun, which will be the smallest gun in the array in terms of energy output (dB) and volume (in^3). Operators will then continue ramp-up by gradually activating additional airguns over a period of at least 30 minutes (but not longer than 40 minutes) until the desired operating level of the airgun array is obtained. This ramp-up procedure will be implemented anytime airguns have not been fired for 30 minutes or more. Airgun ramp-up will not be required if the airguns have been off for less than 30 minutes and visual surveys are continued throughout the silent period

and no marine mammals are observed in the applicable zones during that time. Monitoring will occur during all airgun usage.

3. Oil Spill Plan

BlueCrest developed an Oil Discharge Prevention and Contingency Plan (ODPCP) and has submitted it for approval to Alaska's Department of Environmental Conservation (ADEC). NMFS reviewed the previous ODPCP covering the Cosmopolitan drilling program (prepared by Buccaneer Alaska Operations LLC) during the ESA consultation process for Cosmopolitan leases and found that with implementation of the safety features mentioned above that the risk of an oil spill was discountable. The new ODPCP for operations under BlueCrest was approved on March 30, 2016.

4. Pollution Discharge Plan

When the drill rig is towed or otherwise floating it is classified as a vessel (like a barge). During those periods, it is covered under a form of National Pollutant Discharge Elimination System permit known as a Vessel General Permit. This permit remains federal and is a "no discharge permit," which allows for the discharge of storm water and closed system fire suppression water but no other effluents.

When the legs are down, the drill rig becomes a facility. During those periods, it is covered under an approved APDES. Under the APDES, certain discharges are permitted. However, BlueCrest is not permitted to discharge gray water, black water, or hydrocarboned muds; they are all hauled off and not discharged.

Mitigation Measures Proposed by NMFS

NMFS proposes that: during rig towing operations, speed will be reduced to 8 knots or less, as safety allows, at the approach of any whales or Steller sea lions within 2,000 ft (610 m)

of the towing operations; and when BlueCrest utilizes helicopters for support operations that the helicopters must maintain an altitude of at least 1,000 ft (305 m), except during takeoffs, landings, or emergency situations.

Mitigation Conclusions

NMFS has carefully evaluated BlueCrest's proposed mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of affecting the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another:

- The manner in which, and the degree to which, the successful implementation of the measures are expected to minimize adverse impacts to marine mammals;
 - The proven or likely efficacy of the measures to minimize adverse impacts as planned;
- and
- The practicability of the measures for applicant implementation.

Any mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

1. Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).
2. A reduction in the numbers of marine mammals (total number or number at biologically important time or location) exposed to received levels of seismic airguns, impact hammers, drill rig deep well pumps, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

3. A reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels of seismic airguns impact hammers, drill rig deep well pumps, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

4. A reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of seismic airguns impact hammers, drill rig deep well pumps, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing the severity of harassment takes only).

5. Avoidance or minimization of adverse effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/disturbance of habitat during a biologically important time.

6. For monitoring directly related to mitigation – an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on our evaluation of the applicant's proposed measures, as well as other measures proposed by NMFS, NMFS has preliminarily determined that implementation of these mitigation measures provide the means of effecting the least practicable impact on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must set forth "requirements pertaining to the monitoring and reporting of such taking." The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for ITAs

must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area.

BlueCrest submitted information regarding marine mammal monitoring to be conducted during the proposed drilling program as part of the IHA application. That information can be found in the Appendix of their application. The monitoring measures may be modified or supplemented based on comments or new information received from the public during the public comment period.

Monitoring measures proposed by the applicant or prescribed by NMFS should accomplish one or more of the following top-level goals:

1. An increase in our understanding of the likely occurrence of marine mammal species in the vicinity of the action, i.e., presence, abundance, distribution, and/or density of species.

2. An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammal species to any of the potential stressor(s) associated with the action (e.g. sound or visual stimuli), through better understanding of one or more of the following: the action itself and its environment (e.g. sound source characterization, propagation, and ambient noise levels); the affected species (e.g. life history or dive pattern); the likely co-occurrence of marine mammal species with the action (in whole or part) associated with specific adverse effects; and/or the likely biological or behavioral context of exposure to the stressor for the marine mammal (e.g. age class of exposed animals or known pupping, calving or feeding areas).

3. An increase in our understanding of how individual marine mammals respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level).

4. An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: the long-term fitness and survival of an individual; or the population, species, or stock (e.g. through effects on annual rates of recruitment or survival).

5. An increase in our understanding of how the activity affects marine mammal habitat, such as through effects on prey sources or acoustic habitat (e.g., through characterization of longer-term contributions of multiple sound sources to rising ambient noise levels and assessment of the potential chronic effects on marine mammals).

6. An increase in understanding of the impacts of the activity on marine mammals in combination with the impacts of other anthropogenic activities or natural factors occurring in the region.

7. An increase in our understanding of the effectiveness of mitigation and monitoring measures.

8. An increase in the probability of detecting marine mammals (through improved technology or methodology), both specifically within the safety zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals.

Proposed Monitoring Measures

1. Visual Monitoring

PSOs will be required to monitor the area for marine mammals aboard the drill rig during drilling operations, drive pipe hammering, and VSP operations. Standard marine mammal observing field equipment will be used, including reticule binoculars, Big-eye binoculars, inclinometers, and range-finders. Drive pipe hammering and VSP operations will not occur at night, so PSOs will not be on watch during nighttime. At least one PSO will be on duty at all

times when operations are occurring. Shifts shall not last more than 4 hours, and PSOs will not observe for more than 12 hours in a 24-hour period.

2. Sound Source Verification Monitoring

Sound source verification (SSV) measurements have already been conducted for the *Spartan151* and all other sound generating activities planned at the Cosmopolitan well site by MAI (2011). No SSV measurements are planned at this time for the 2016 program.

Reporting Measures

1. 90-Day Technical Report

Daily field reports will be prepared that include daily activities, marine mammal monitoring efforts, and a record of the marine mammals and their behaviors and reactions observed that day. These daily reports will be used to help generate the 90-day technical report. A report will be due to NMFS no later than 90 days after the expiration of the IHA (if issued). The Technical Report will include the following:

- Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals).
- Analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare).
- Species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover.
- Analyses of the effects of operations.
- Sighting rates of marine mammals (and other variables that could affect detectability),

such as: (i) initial sighting distances versus operational activity state; (ii) closest point of approach versus operational activity state; (iii) observed behaviors and types of movements versus operational activity state; (iv) numbers of sightings/individuals seen versus operational activity state; (v) distribution around the drill rig versus operational activity state; and (vi) estimates of take by Level B harassment based on presence in the Level B harassment zones.

2. Notification of Injured or Dead Marine Mammals

In the unanticipated event that BlueCrest's specified activity clearly causes the take of a marine mammal in a manner prohibited by the IHA (if issued), such as an injury (Level A harassment), serious injury or mortality (e.g., ship-strike, gear interaction, and/or entanglement), BlueCrest would immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, the Alaska Region Protected Resources Division, NMFS, and the Alaska Regional Stranding Coordinators. The report would include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound source use in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;

- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

Activities would not resume until NMFS is able to review the circumstances of the prohibited take. NMFS would work with BlueCrest to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. BlueCrest would not be able to resume their activities until notified by NMFS via letter, email, or telephone.

In the event that BlueCrest discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (i.e., in less than a moderate state of decomposition as described in the next paragraph), BlueCrest would immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, the Alaska Region Protected Resources Division, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators. The report would include the same information identified in the paragraph above. If the observed marine mammal is dead, activities would be able to continue while NMFS reviews the circumstances of the incident. If the observed marine mammal is injured, measures described below must be implemented. NMFS would work with BlueCrest to determine whether modifications in the activities are appropriate.

In the event that BlueCrest discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in the IHA (e.g., carcass with moderate to advanced decomposition, or scavenger damage), BlueCrest would report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, the Alaska Region Protected Resources

Division, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators, within 24 hours of the discovery. BlueCrest would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. If the observed marine mammal is dead, activities may continue while NMFS reviews the circumstances of the incident. If the observed marine mammal is injured, measures described below must be implemented. In this case, NMFS will notify BlueCrest when activities may resume.

3. Injured Marine Mammals

The following describe the specific actions BlueCrest must take if a live marine mammal stranding is reported in Cook Inlet coincident to, or within 72 hours of seismic activities involving the use of airguns. A live stranding event is defined as a marine mammal: (i) on a beach or shore of the United States and unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in apparent need of medical attention; or (iii) in the waters under the jurisdiction of the United States (including navigable waters) but is unable to return to its natural habitat under its own power or without assistance.

The shutdown procedures described here are not related to the investigation of the cause of the stranding and their implementation is in no way intended to imply that BlueCrest's airgun operation is the cause of the stranding. Rather, shutdown procedures are intended to protect marine mammals exhibiting indicators of distress by minimizing their exposure to possible additional stressors, regardless of the factors that initially contributed to the stranding.

Should BlueCrest become aware of a live stranding event (from NMFS or another source), BlueCrest must immediately implement a shutdown of the airgun array. A shutdown must be implemented whenever the animal is within 5 km of the airgun array. Shutdown

procedures will remain in effect until NMFS determines that, and advises BlueCrest that, all live animals involved in the stranding have left the area (either of their own volition or following herding by responders).

Within 48 hours of the notification of the live stranding event, BlueCrest must inform NMFS where and when they were operating airguns and at what discharge volumes. BlueCrest must appoint a contact who can be reached 24/7 for notification of live stranding events. Immediately upon notification of the live stranding event, this person must order the immediate shutdown of the airguns. These conditions are in addition to those noted above.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]. Only take by Level B behavioral harassment of some species is anticipated as a result of the proposed drilling program. Anticipated impacts to marine mammals are associated with noise propagation from the sound sources (e.g., drill rig and tow, airguns, and impact hammer) used in the drilling program. Additional disturbance to marine mammals may result from visual disturbance of the drill rig or support vessels. No take is expected to result from vessel strikes because of the slow speed of the vessels (2-4 knots while rig is under tow; 7-8 knots for supply barges).

BlueCrest requests authorization to take nine marine mammal species by Level B harassment. These nine marine mammal species are: beluga whale; humpback whale; gray

whale; minke whale; killer whale; harbor porpoise; Dall’s porpoise; Steller sea lion; and harbor seal. In April 2013, NMFS Section 7 ESA biologists concurred that Buccaneer’s proposed Cosmopolitan exploratory drilling program was not likely to adversely affect Cook Inlet beluga whales or beluga whale critical habitat. Since the sale of the Cosmopolitan leases from Buccaneer to BlueCrest and the slight change in the program (e.g., drilling of up to three wells instead of two), Mitigation measures requiring shutdowns of activities before belugas enter the Level B harassment zones will be required in any issued IHA. Therefore, the potential for take of belugas would be eliminated; however, a small number of takes are included to cover any unexpected or accidental take.

As noted previously in this document, for continuous sounds, for impulse sounds such as those produced by the airgun array during the VSP surveys or the impact hammer during drive pipe hammering, NMFS uses a received level of 160-dB (rms) to indicate the onset of Level B harassment. The current Level A (injury) harassment threshold is 180 dB (rms) for cetaceans and 190 dB (rms) for pinnipeds. Table 3 outlines the current acoustic criteria.

Table 3. Acoustic Exposure Criteria Used by NMFS.

Criterion	Criterion Definition	Threshold
Level A Harassment (Injury)	Permanent Threshold Shift (PTS) (Any level above that which is known to cause TTS)	180 dB re 1 microPa-m (cetaceans) / 190 dB re 1 microPa-m (pinnipeds) root mean square (rms)
Level B Harassment	Behavioral Disruption (for impulse noises)	160 dB re 1 microPa-m (rms)

Section 6 of BlueCrest’s application contains a description of the methodology used by BlueCrest to estimate takes by harassment, including calculations for the 120 dB (rms) and 160 dB (rms) isopleths and marine mammal densities in the areas of operation (see ADDRESSES), which is also provided in the following sections. NMFS verified BlueCrest’s methods, and used

the density and sound isopleth measurements in estimating take. However, NMFS also include a duration factor in the estimates presented below, which is not included in BlueCrest's application.

The proposed take estimates presented in this section were calculated by multiplying the best available density estimate for the species (from NMFS aerial surveys 2005-2014) by the area of ensonification for each type of activity by the total number of days that each activity would occur. While the density and sound isopleth data helped to inform the decision for the proposed estimated take levels for harbor porpoises and harbor seals, NMFS also considered the information regarding marine mammal sightings during BlueCrest's 2013 Cosmopolitan #A-1 drilling program. Additional detail is provided next.

Ensonified Areas

Drive Pipe Hammering

The Delmar D62-22 diesel impact hammer proposed to be used by BlueCrest to drive the 30-inch drive pipe was previously acoustically measured by Blackwell (2005) in upper Cook Inlet. She found that sound exceeding 190 dB Level A noise limits for pinnipeds extend to about 200 ft (60 m), and 180 dB Level A impacts to cetaceans to about 820 ft (250 m). Level B disturbance levels of 160 dB extended to just less than 1 mi (1.6 km). The associated ZOI (area ensonified by noise greater than 160 dB) is 8.3 km² (3.1 mi²).

VSP Airguns

Illingworth and Rodkin (2014) measured noise levels during VSP operations associated with post-drilling operations at the Cosmopolitan #A-1 site in lower Cook Inlet during July 2013. The results indicated that the 720 cubic inch airgun array used during the operation produced noise levels exceeding 160 dB re 1 µPa out to a distance of approximately 8,100 ft (2,470 m).

Based on these results, the associated ZOI would be 19.17 km² (7.4 mi²). See Table 4.

Table 4. Zones of Influence for Proposed Activities.

	Drive Pipe Hammering	VSP Airguns
ZOI (km ²)	8.3	19.17

Marine Mammal Densities

Density estimates were derived for Cook Inlet marine mammals other than belugas as described above. An average density was derived for each species based on NMFS aerial survey data from 2005-2014.

For belugas, the ensonified area associated with each activity was overlaid on a map of the density cells derived in Goetz et al. (2012), the cells falling within each ensonified area were quantified, and average cell density calculated. Figure 6-1 in BlueCrest's application shows the associated ensonified areas and beluga density contours relative to the rig tow beginning from Port Graham, while Figure 6-2 shows the same but assumes the rig tow to the well site will begin in upper Cook Inlet. The quantified results are found in Table 5 below, and show that throughout the proposed activity areas the beluga densities are very low.

Table 5. Mean Raw Densities of Beluga Whales with Activity Action Areas Based on the Goetz et al. (2012) Cook Inlet Beluga Whale Distribution Modeling.

Activity	Number of Cells	Mean Density	Density Range
Pipe Driving	8	0.000344	0.000200 - 0.000562
VSP	19	0.000346	0.000136 - 0.000755

This data was then multiplied by the area ensonified in one day, then multiplied by the number of expected days of each type of operation.

Proposed Take Estimates

As noted previously in this document, the potential number of animals that might be exposed to receive continuous SPLs of ≥ 120 dB re 1 μ Pa (rms) and pulsed SPLs of ≥ 160 dB re 1 μ Pa (rms) was calculated by multiplying:

- the expected species density;
- the anticipated area to be ensonified (zone of influence [ZOI]); and
- the estimated total duration of each of the activities expressed in days (24 hrs).

To derive at an estimated total duration for each of the activities the following assumptions were made:

- The maximum total duration of impact hammering during drive pipe driving would be 3 days (however, the hammer would not be used continuously over that time period).
- The total duration of the VSP data acquisition runs is estimated to be up to 2 days (however, the airguns would not be used continuously over that time period).

Using all of these assumptions, Table 6 outlines the total number of Level B harassment exposures for each species from each of the four activities using the calculation and assumptions described here.

Table 6. Potential Number of Exposures to Level B Harassment Thresholds During BlueCrest's Proposed Drilling Program During the 2016 Open Water Season.

Species	Pipe Driving	VSP	Total
Beluga whale	0.1	0.1	0.2
Gray whale	<1	<1	<1
Harbor seal	20.7	31.9	52.6
Harbor porpoise	0.3	0.5	0.8
Killer whale	0.1	0.1	0.2
Steller sea	0.7	1.0	1.7

lion			
Minke whale	<1	<1	<1
Humpback whale	0.1	0.1	0.2
Dall's porpoise	<1	<1	<1

In the IHA application, BlueCrest notes that these estimates may be low regarding harbor porpoise and killer whales, and high regarding harbor seals, based on 2013 marine mammal monitoring data (Owl Ridge, 2014). During the 2013 monitoring, 152 harbor porpoise were observed within about 2 km (1.2 mi). If we assume that the 1,999 hours of observation effort in 2013 equates to about 83 days (24-hr periods), then we can assume that about 2 harbor porpoise were recorded for every 24 hr of monitoring effort in 2013. Consequently, it is reasonable to assume that the 15 total days of activity associated with pipe driving and VSP combined could expose approximately 30 harbor porpoise. Following this same logic, the 17 killer whales, 77 harbor seals, and 7 Steller sea lions that were observed within about 2 km (1.2 mi) in 2013, would equate to an expectation of about 3 killer whale, 14 harbor seals, and 1 Steller sea lion occurring within 2 km (1.2 mi) of the rig during the planned 15 total days of pipe driving and VSP activity. The larger of the two estimates was used for each species.

For the less common marine mammals such as gray, minke, and killer whales and Dall's porpoises, population estimates within lower Cook Inlet yield low density estimates. Still, at even very low densities, it is possible to encounter these marine mammals during BlueCrest operations, as evidenced by the 2013 marine mammal sighting data. Marine mammals may approach the drilling rig out of curiosity, and animals may approach in a group. Thus, requested take authorizations for these species are primarily based on average group size, the potential for

attraction, and the 2013 marine mammal sighting data (with buffers added in to account for missed sightings).

Table 7 outlines density estimates, number of NMFS' proposed Level B harassment takes, the abundance of each species in Cook Inlet, the percentage of each species or stock estimated to be taken, and current population trends.

Table 7. Density Estimates, Proposed Number of Level B Harassment Takes Species or Stock Abundance, Percentage of Population Proposed to be Taken, and Species Trend Status.

Species	Density (#/km ²)	Proposed Level B Takes	Abundance	Percentage of Population	Trend
Beluga whale	See Table 4	5	312	1.6	Decreasing
Gray whale	9.46E-05	5	19,126	<0.1	Stable/increasing
Harbor Seal	0.2769	53	22,900	0.2	Stable
Harbor Porpoise	0.0042	15	31,046	0.1	No reliable information
Killer Whale	0.0008	15	2,347 (resident); 587(transient)	0.6 (resident); 2.6 (transient)	Resident stock possibly increasing Transient stock stable
Steller sea lion	0.0091	25	55,422	0.1	Decreasing with regional variability (some increasing or stable)
Minke whale	1.14E-05	5	1,233	0.4	No reliable information
Humpback whale	0.0012	15	10,103	0.2	Southeast Alaska increasing
Dall's porpoise	0.0002	25	83,400	0.3	No reliable information

Analysis and Preliminary Determinations

Negligible Impact

Negligible impact is “an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival” (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes, alone, is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be “taken” through behavioral harassment, NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, feeding, migration, etc.), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, effects on habitat, and the status of the species. To avoid repetition, the discussion of our analyses applies to all the species listed in Table 7, given that the anticipated effects of this project on marine mammals are expected to be relatively similar in nature. There is no information about the size, status, or structure of any species or stock that would lead to a different analysis for this activity, except where species-specific factors are identified and analyzed.

No injuries or mortalities are anticipated to occur as a result of BlueCrest’s proposed drilling program, and none are proposed to be authorized. Injury, serious injury, or mortality could occur if there were a large or very large oil spill. However, as discussed previously in this document, the likelihood of a spill is discountable. BlueCrest has implemented many design and operational standards to mitigate the potential for an oil spill of any size. NMFS does not propose to authorize take from an oil spill, as it is not part of the specified activity. Additionally, animals in the area are not expected to incur hearing impairment (i.e., TTS or PTS) or non-

auditory physiological effects. Instead, any impact that could result from BlueCrest's activities is most likely to be behavioral harassment and is expected to be of limited duration. The marine mammals estimated to be taken represent small percentages of their respective species or stocks.

The proposed drilling program does not fall within critical habitat designated in Cook Inlet for beluga whales or within critical habitat designated for Steller sea lions. The Cosmopolitan State unit is nearly 100 mi south of beluga whale Critical Habitat Area 1 and approximately 27 mi south of Critical Habitat Area 2. It is also located about 25 mi north of the isolated patch of Critical Habitat Area 2 found in Kachemak Bay. Area 2 is based on dispersed fall and winter feeding and transit areas in waters where whales typically appear in smaller densities or deeper waters (76 FR 20180, April 11, 2011). During the proposed period of operations, the majority of Cook Inlet beluga whales will be in Critical Habitat Area 1, well north of the proposed drilling area. The proposed activities are not anticipated to adversely affect beluga whale critical habitat, and mitigation measures and safety protocols are in place to reduce any potential even further.

Sound levels emitted during the proposed activity are anticipated to be low overall with the exception of impact hammering and VSP operations. The continuous sounds produced by the drill rig do not rise to the level thought to cause take in marine mammals. Additionally, impact hammering and airgun operations will occur for extremely limited time periods (for a few hours at a time for 1-3 days and for a few hours at a time for 1-2 days, respectively). Moreover, auditory injury has not been noted in marine mammals from these activities. Mitigation measures proposed for inclusion in any issued IHA will reduce these potentials even further.

The addition of the jack-up rig and a few support vessels and sound due to rig and vessel operations associated with the drilling program would not be outside the present experience of

marine mammals in Cook Inlet, although levels may increase locally. Given the large number of vessels in Cook Inlet and the apparent habituation to vessels by Cook Inlet marine mammals that may occur in the area, vessel activity and sound is not expected to have effects that could cause significant or long-term consequences for individual marine mammals or their populations.

Potential impacts to marine mammal habitat were discussed previously in this document (see the “Anticipated Effects on Habitat” section). Although some disturbance is possible to food sources of marine mammals, the impacts are anticipated to be minor enough as to not affect annual rates of recruitment or survival of marine mammals in the area. Based on the size of Cook Inlet where feeding by marine mammals occurs versus the localized area of drilling program activities, any missed feeding opportunities in the direct project area would be minor based on the fact that other feeding areas exist elsewhere nearby. Additionally, the direct project area is not within in the primary beluga feeding and calving habitat.

Taking into account the mitigation measures that are planned, effects on marine mammals are generally expected to be restricted to avoidance of a limited area around the drilling operation and short-term changes in behavior, falling within the MMPA definition of “Level B harassment.” Animals are not expected to permanently abandon any area that is part of the drilling operations, and any behaviors that are interrupted during the activity are expected to resume once the activity ceases. Only a small portion of marine mammal habitat will be affected at any time, and other areas within Cook Inlet will be available for necessary biological functions. Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from BlueCrest’s proposed drilling program will not adversely affect annual rates

of recruitment or survival, and therefore will have a negligible impact on the affected marine mammal species or stocks.

Small Numbers

The requested takes proposed to be authorized for each species are presented in Table 7 above. The proposed authorized takes for each species represent percentages ranging from <0.1 up to 1.6 of the respective stock population estimates for each species. These estimates represent the percentage of each species or stock that could be taken by Level B behavioral harassment if each animal is taken only once. The numbers of marine mammals taken are small relative to the affected species or stock sizes. In addition, the mitigation and monitoring measures (described previously in this document) proposed for inclusion in the IHA (if issued) are expected to reduce even further any potential disturbance to marine mammals. NMFS preliminarily finds that small numbers of marine mammals will be taken relative to the populations of the affected species or stocks.

Impact on Availability of Affected Species for Taking for Subsistence Uses

Relevant Subsistence Uses

The subsistence harvest of marine mammals transcends the nutritional and economic values attributed to the animal and is an integral part of the cultural identity of the region's Alaska Native communities. Inedible parts of the whale provide Native artisans with materials for cultural handicrafts, and the hunting itself perpetuates Native traditions by transmitting traditional skills and knowledge to younger generations (NOAA, 2007).

The Cook Inlet beluga whale has traditionally been hunted by Alaska Natives for subsistence purposes. For several decades prior to the 1980s, the Native Village of Tyonek residents were the primary subsistence hunters of Cook Inlet beluga whales. During the 1980s

and 1990s, Alaska Natives from villages in the western, northwestern, and North Slope regions of Alaska either moved to or visited the south central region and participated in the yearly subsistence harvest (Stanek, 1994). From 1994 to 1998, NMFS estimated 65 whales per year (range 21-123) were taken in this harvest, including those successfully taken for food and those struck and lost. NMFS has concluded that this number is high enough to account for the estimated 14 percent annual decline in the population during this time (Hobbs *et al.*, 2008). Actual mortality may have been higher, given the difficulty of estimating the number of whales struck and lost during the hunts. In 1999, a moratorium was enacted (Public Law 106-31) prohibiting the subsistence take of Cook Inlet beluga whales except through a cooperative agreement between NMFS and the affected Alaska Native organizations. Since the Cook Inlet beluga whale harvest was regulated in 1999 requiring cooperative agreements, five beluga whales have been struck and harvested. Those beluga whales were harvested in 2001 (one animal), 2002 (one animal), 2003 (one animal), and 2005 (two animals). The Native Village of Tyonek agreed not to hunt or request a hunt in 2007, when no co-management agreement was to be signed (NMFS, 2008a).

On October 15, 2008, NMFS published a final rule that established long-term harvest limits on Cook Inlet beluga whales that may be taken by Alaska Natives for subsistence purposes (73 FR 60976). That rule prohibits harvest for a 5-year interval period if the average stock abundance of Cook Inlet beluga whales over the prior five-year interval is below 350 whales. Harvest levels for the current 5-year planning interval (2013-2017) are zero because the average stock abundance for the previous five-year period (2008-2012) was below 350 whales. Based on the average abundance over the 2002-2007 period, no hunt occurred between 2008 and 2012 (NMFS, 2008a). The Cook Inlet Marine Mammal Council, which managed the Alaska Native

Subsistence fishery with NMFS, was disbanded by a unanimous vote of the Tribes' representatives on June 20, 2012. At this time, no harvest is expected in 2016.

Data on the harvest of other marine mammals in Cook Inlet are sparse. Some data are available on the subsistence harvest of harbor seals, harbor porpoises, and killer whales in Alaska in the marine mammal stock assessments. However, these numbers are for the Gulf of Alaska including Cook Inlet, and they are not indicative of the harvest in Cook Inlet.

Some detailed information on the subsistence harvest of harbor seals is available from past studies conducted by the Alaska Department of Fish & Game (Wolfe *et al.*, 2009). In 2008, only 33 harbor seals were taken for harvest in the Upper Kenai-Cook Inlet area. In the same study, reports from hunters stated that harbor seal populations in the area were increasing (28.6%) or remaining stable (71.4%). The specific hunting regions identified were Anchorage, Homer, Kenai, and Tyonek, and hunting generally peaks in March, September, and November (Wolfe *et al.*, 2009). Since 1992, Alaska Natives from the Cook Inlet villages of Homer and Kenai have annually taken (harvested plus struck and lost) an average of 14-15 harbor seals. There are no data for Ninilchik alone. The villages are located between 14 mi (Ninilchik) and 50 mi (Kenai) away from the Cosmopolitan well site.

Potential Impacts to Subsistence Uses

Section 101(a)(5)(D) also requires NMFS to determine that the authorization will not have an unmitigable adverse effect on the availability of marine mammal species or stocks for subsistence use. NMFS has defined "unmitigable adverse impact" in 50 CFR 216.103 as: an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii)

Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

The primary concern is the disturbance of marine mammals through the introduction of anthropogenic sound into the marine environment during the proposed drilling program. Marine mammals could be behaviorally harassed and either become more difficult to hunt or temporarily abandon traditional hunting grounds. If a large or very large oil spill occurred, it could impact subsistence species. However, as previously mentioned, oil spill is not anticipated to occur (nor authorized), and measures have been taken to prevent a large or very large oil spill. Oil spill trajectory scenarios developed in preparation of the ODPCP indicate that potential spills would travel south through the central channel of Cook Inlet, away from shoreline subsistence harvest areas. The proposed drilling program should not have any impacts to beluga harvests as none currently occur in Cook Inlet. Additionally, subsistence harvests of other marine mammal species are limited in Cook Inlet and typically occur in months when the proposed drilling program would not operate.

The proposed mitigation measures described earlier in this document will reduce impacts to any hunts of harbor seals or other marine mammal species that may occur in Cook Inlet. These measures will ensure that marine mammals are available to subsistence hunters.

Unmitigable Adverse Impact Analysis and Preliminary Determination

The project will not have any effect on current beluga whale harvests because no beluga harvest will take place in 2016. Additionally, the proposed drilling area is not an important native subsistence site for other subsistence species of marine mammals. Also, because of the relatively small proportion of marine mammals utilizing Cook Inlet, the number harvested in any

future hunts would be expected to be extremely low. Therefore, because the proposed program would result in only temporary disturbances, the drilling program would not impact the availability of these other marine mammal species for subsistence uses.

The timing and location of subsistence harvest of Cook Inlet harbor seals may coincide with BlueCrest's project late in the proposed drilling season, but because this subsistence hunt is conducted opportunistically and at such a low level (NMFS, 2013c), BlueCrest's program is not expected to have an impact on the subsistence use of harbor seals.

NMFS anticipates that any effects from BlueCrest's proposed drilling program on marine mammals, especially harbor seals and Cook Inlet beluga whales, which are or have been taken for subsistence uses, would be short-term, site specific, and limited to inconsequential changes in behavior. NMFS does not anticipate that the authorized taking of affected species or stocks will reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (1) Causing the marine mammals to abandon or avoid hunting areas; (2) directly displacing subsistence users; or (3) placing physical barriers between the marine mammals and the subsistence hunters; and that cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met. In the unlikely event of a major oil spill in Cook Inlet, there could be major impacts on the availability of marine mammals for subsistence uses. As discussed earlier in this document, the probability of a major oil spill occurring over the life of the project is low. Additionally, BlueCrest developed an ODPCP. Based on the description of the specified activity, the measures described to minimize adverse effects on the availability of marine mammals for subsistence purposes, and the proposed mitigation and monitoring measures, NMFS has preliminarily determined that there will not be an unmitigable adverse impact on marine mammal availability for taking for

subsistence uses from BlueCrest's proposed activities.

Endangered Species Act (ESA)

Cook Inlet beluga whales are listed as endangered under the ESA. The U.S. Army Corps of Engineers consulted with NMFS on an earlier version of this proposed project pursuant to section 7 of the ESA. On April 25, 2013, NMFS concurred with the conclusion that the proposed exploratory drilling program in lower Cook Inlet is not likely to adversely affect beluga whales, beluga whale critical habitat, or Steller sea lion critical habitat. However, due to the monitoring conducted at the well site in 2013, NMFS concluded that Section 7 consultation is necessary, as listed species, particularly Steller sea lions, humpback whales, and belugas, may be affected. Therefore, NMFS is undertaking consultation pursuant to section 7 of the ESA as part of this activity.

National Environmental Policy Act (NEPA)

NMFS has prepared a Programmatic Draft Environmental Assessment (EA) for issuance of IHAs for oil and gas activities in Cook Inlet for the 2016 open water season (including BlueCrest's activities). The Draft EA was made available for public comment in February, 2016 (81 FR 12474). Public comments received on the Draft EA will either be incorporated into the final EA and a Finding of No Significant Impact (FONSI) will be issued, or an Environmental Impact Statement (EIS) will be prepared prior to issuance of the IHA (if issued).

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to BlueCrest for conducting an oil and gas production drilling program in lower Cook Inlet during the 2016 open water season, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The proposed IHA language is provided next.

This section contains a draft of the IHA itself. The wording contained in this section is proposed for inclusion in the IHA (if issued).

1. This IHA is valid from August 1, 2016 through June 30, 2017.

2. This IHA is valid only for activities associated with BlueCrest's lower Cook Inlet oil and gas production drilling program. The specific areas where BlueCrest's drilling operations will occur are described in the April, 2016 IHA application and depicted in Figure 1 of the application.

3. Species Authorized and Level of Take

The incidental taking of marine mammals, by Level B harassment only, is limited to the following species in the waters of Cook Inlet:

Common Name	Scientific Name	Number of Takes
Odontocetes:		
Beluga whale	<i>Delphinapterus leucas</i>	5
Harbor porpoise	<i>Phocoena phocoena</i>	15
Dall's porpoise	<i>Phocoenoides dalli</i>	25
Killer whale	<i>Orcinus orca</i>	15
Mysticetes:		
Gray whale	<i>Eschrichtius robustus</i>	5
Minke whale	<i>Balaenoptera acutorostrata</i>	5
Humpback whale	<i>Megaptera novaeangliae</i>	15
Pinnipeds:		
Harbor seal	<i>Phoca vitulina richardii</i>	53

Steller sea lion	<i>Eumetopias jubatus</i>	25
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If any marine mammal species not listed above are encountered during operations and are likely to be exposed to sound pressure levels (SPLs) greater than or equal to 160 dB re 1 μ Pa (rms) for impulse sources or greater than or equal to 120 dB re 1 μ Pa (rms), then the Holder of this IHA must shut-down the sound source prior to the animal entering the applicable Level B isopleth to avoid take.

4. The authorization for taking by harassment is limited to the following acoustic sources (or sources with comparable frequency and intensity) and from the following activities:

- a. airgun array with a total discharge volume of 720 in³; and
- b. impact hammer during drive pipe driving.

5. The taking of any marine mammal in a manner prohibited under this IHA must be reported immediately to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS or her designee.

6. The holder of this IHA must notify the Chief of the Permits and Conservation Division, Office of Protected Resources, as well as the Field Supervisor of the Protected Resources Division in the Alaska Regional Office at least 48 hours prior to the start of exploration drilling activities (unless constrained by the date of issuance of this IHA in which case notification shall be made as soon as possible).

7. Mitigation and Monitoring Requirements: The Holder of this IHA is required to implement the following mitigation and monitoring requirements when conducting the specified activities to achieve the least practicable impact on affected marine mammal species or stocks:

- a. Utilize at least two qualified, vessel-based Protected Species Observers (PSOs) to

visually watch for and monitor marine mammals near the drill rig during specified activities below (drive pipe hammering and VSP activities) before and during start-ups of sound sources day or night, allowing for one PSO to be on-duty while the other is off duty. PSOs shall have access to reticle binoculars, big-eye binoculars, and night vision devices. PSO shifts shall last no longer than 4 hours at a time. PSOs shall also make observations during daytime periods when the sound sources are not operating for comparison of animal abundance and behavior, when feasible. When practicable, as an additional means of visual observation, drill rig or vessel crew may also assist in detecting marine mammals.

b. When a mammal sighting is made, the following information about the sighting will be recorded:

i. Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from the PSO, apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;

ii. Time, location, speed, activity of the vessel, sea state, ice cover, visibility, and sun glare;

iii. The positions of other vessel(s) in the vicinity of the PSO location (if applicable);

iv. The rig's position and water depth, sea state, ice cover, visibility, and sun glare will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a change in any of those variables.

c. Within safe limits, the PSOs should be stationed where they have the best possible viewing;

d. PSOs should be instructed to identify animals as unknown where appropriate rather

than strive to identify a species if there is significant uncertainty;

e. Drive Pipe Hammering Mitigation Measures:

i. PSOs will observe from the drill rig during impact hammering out to the 160 dB (rms) radius of 1.6 km (1 mi). If marine mammal species for which take is not authorized, or if any listed species (beluga whales, humpback whales, or Steller sea lions) are about to enter this zone, then use of the impact hammer must cease.

ii. If cetaceans approach or enter within the 180 dB (rms) radius of 250 m (820 ft) or if pinnipeds approach or enter within the 190 dB (rms) radius of 60 m (200 ft), then use of the impact hammer must cease. Following a shutdown of impact hammering activities, the applicable zones must be clear of marine mammals for at least 30 minutes prior to restarting activities.

iii. PSOs will visually monitor out to the 160 dB radius for at least 30 minutes prior to the initiation of activities. If no marine mammals are detected during that time, then BlueCrest can initiate impact hammering using a “soft start” technique. Hammering will begin with an initial set of three strikes at 40 percent energy followed by a 1 min waiting period, then two subsequent three-strike sets. This “soft-start” procedure will be implemented anytime impact hammering has ceased for 30 minutes or more. Impact hammer “soft-start” will not be required if the hammering downtime is for less than 30 minutes and visual surveys are continued throughout the silent period, and no marine mammals are observed in the applicable zones during that time.

f. VSP Airgun Mitigation Measures:

i. PSOs will observe from the drill rig during airgun operations out to the 160 dB radius of 2.5 km (1.55 mi). If marine mammal species for which take is not authorized, or if any listed species (beluga whales, humpback whales, or Steller sea lions) are about to enter this zone, then

use of the airguns will cease.

ii. If cetaceans approach or enter within the 180 dB (rms) radius of 240 m (787 ft) or if pinnipeds approach or enter within the 190 dB (rms) radius of 120 m (394 ft), then use of the airguns will cease. Following a shutdown of airgun operations, the applicable zones must be clear of marine mammals for at least 30 minutes prior to restarting activities.

iii. PSOs will visually monitor out to the 160 dB radius for at least 30 minutes prior to the initiation of activities. If no marine mammals are detected during that time, then BlueCrest can initiate airgun operations using a “ramp-up” technique. Airgun operations will begin with the firing of a single airgun, which will be the smallest gun in the array in terms of energy output (dB) and volume (in³). Operators will then continue ramp-up by gradually activating additional airguns over a period of at least 30 minutes (but not longer than 40 minutes) until the desired operating level of the airgun array is obtained. This ramp-up procedure will be implemented anytime airguns have not been fired for 30 minutes or more. Airgun ramp-up will not be required if the airguns have been off for less than 10 minutes and visual surveys are continued throughout the silent period, and no marine mammals are observed in the applicable zones during that time.

g. No initiation of survey operations involving the use of sound sources is permitted from a shutdown position at night or during low-light hours (such as in dense fog or heavy rain).

h. During rig towing operations, speed will be reduced to 8 knots or less, as safety allows, at the approach of any whales or Steller sea lions within 2,000 ft (610 m) of the towing operations.

i. Helicopters must maintain an altitude of at least 1,000 ft (305 m), except during takeoffs, landings, or emergency situations.

8. Reporting Requirements: The Holder of this IHA is required to:

a. Submit a draft Technical Report on all activities and monitoring results to NMFS' Permits and Conservation Division within 90 days of expiration of the IHA. The Technical Report will include:

i. Summaries of monitoring effort (total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals);

ii. Analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare);

iii. Species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover;

iv. Analyses of the effects of the proposed project activities on marine mammal behaviors;

v. Sighting rates of marine mammals during periods with and without drilling operation activities (and other variables that could affect detectability), such as: (A) initial sighting distances versus activity state; (B) closest point of approach versus activity state; (C) observed behaviors and types of movements versus activity state; (D) numbers of sightings/individuals seen versus activity state; (E) distribution around the drill rig versus activity state; and (F) estimates of take by Level B harassment based on presence in the 120 dB and 160 dB harassment zones.

b. Submit a final report to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, within 30 days after receiving comments from NMFS on the draft technical report. If NMFS has no comments on the draft technical report, the draft report shall be

considered to be the final report.

9. a. In the unanticipated event that BlueCrest's specified activity clearly causes the take of a marine mammal in a manner prohibited by this IHA, such as an injury (Level A harassment), serious injury, or mortality (e.g., ship-strike, gear interaction, and/or entanglement), BlueCrest shall immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, the Alaska Region Protected Resources Division, NMFS, and the Alaska Regional Stranding Coordinators. The report must include the following information:

- i. Time, date, and location (latitude/longitude) of the incident;
- ii. The name and type of vessel involved;
- iii. The vessel's speed during and leading up to the incident;
- iv. Description of the incident;
- v. Status of all sound source use in the 24 hours preceding the incident;
- vi. Water depth;
- vii. Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- viii. Description of marine mammal observations in the 24 hours preceding the incident;
- ix. Species identification or description of the animal(s) involved;
- x. The fate of the animal(s); and
- xi. Photographs or video footage of the animal (if equipment is available).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with BlueCrest to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. BlueCrest may not

resume their activities until notified by NMFS via letter or email, or telephone.

b. In the event that BlueCrest discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (i.e., in less than a moderate state of decomposition as described in the next paragraph), BlueCrest will immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, the Alaska Region Protected Resources Division, NMFS, and the NMFS Alaska Stranding Hotline. The report must include the same information identified in the Condition 9(a) above. If the observed marine mammal is dead, activities may continue while NMFS reviews the circumstances of the incident. If the observed marine mammal is injured, measures described in Condition 10 below must be implemented. NMFS will work with BlueCrest to determine whether modifications in the activities are appropriate.

c. In the event that BlueCrest discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in Condition 2 of this IHA (e.g., carcass with moderate to advanced decomposition or scavenger damage), BlueCrest shall report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, the Alaska Region Protected Resources Division, NMFS, the NMFS Alaska Stranding Hotline (1-877-925-7773), and the Alaska Regional Stranding Coordinators within 24 hours of the discovery. BlueCrest shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. If the observed marine mammal is dead, activities may continue while NMFS reviews the circumstances of the incident. If the observed marine mammal is injured, measures described in Condition 10 below must be

implemented. In this case, NMFS will notify BlueCrest when activities may resume.

10. The following measures describe the specific actions BlueCrest must take if a live marine mammal stranding is reported in Cook Inlet coincident to, or within 72 hours of seismic survey activities involving the use of airguns. A live stranding event is defined as a marine mammal: (i) on a beach or shore of the United States and unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in apparent need of medical attention; or (iii) in the waters under the jurisdiction of the United States (including navigable waters) but is unable to return to its natural habitat under its own power or without assistance.

a. Should BlueCrest become aware of a live stranding event (from NMFS or another source), BlueCrest must immediately implement a shutdown of the airgun array.

i. A shutdown must be implemented whenever the animal is within 5 km of the seismic airguns.

ii. Shutdown procedures will remain in effect until NMFS determines that, and advises BlueCrest that, all live animals involved in the stranding have left the area (either of their own volition or following herding by responders).

b. Within 48 hours of the notification of the live stranding event, BlueCrest must inform NMFS where and when they were operating airguns and at what discharge volumes.

c. BlueCrest must appoint a contact who can be reached 24/7 for notification of live stranding events. Immediately upon notification of the live stranding event, this person must order the immediate shutdown of the airguns.

d. These conditions are in addition to Condition 9.

11. Activities related to the monitoring described in this IHA do not require a separate

scientific research permit issued under section 104 of the MMPA.

12. A copy of this IHA must be in the possession of all contractors and PSOs operating under the authority of this IHA.

13. Penalties and Permit Sanctions: Any person who violates any provision of this IHA is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the MMPA.

14. This IHA may be modified, suspended or withdrawn if the Holder fails to abide by the conditions prescribed herein or if NMFS determines the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals, or if there is an unmitigable adverse impact on the availability of such species or stocks for subsistence uses.

Request for Public Comments

NMFS requests comment on our analysis, the draft authorization, and any other aspect of the Notice of Proposed IHA for BlueCrest's proposed lower Cook Inlet oil and gas production drilling program. Please include with your comments any supporting data or literature citations to help inform our final decision on BlueCrest's request for an MMPA authorization.

Dated: May 26, 2016.

Donna S. Wieting,

Director,

Office of Protected Resources,

National Marine Fisheries Service.

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